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THE INDEPENDENT TELEPHONE CONVENTION.

With this number is issued a supplement, giving the proceedings of the Independent Telephone Association, whose convention at Philadelphia closed on Thursday afternoon. The meeting, as will be seen, was very much of a success, and it would have certainly been more so but for the recent local meeting at Chicago, which was allowed to fall just far enough ahead to take some of the edge off the larger and more important affair. If one thing stands evident, it is that the work of the national body should be helped and not hindered by that of State and subordinate organizations.

As to the proceedings themselves, it must be confessed that there was by no means the kind of programme that one is entitled to expect after five years of existence, and from a body with so much talent in its membership. There was again too much of the "barbaric yawp" about Bell villainy and Bell tactics and the wiles of monopoly. There are just as many good men and true in Bell ranks as in those of the "independents," and as for "monopoly," the existence of some 5,000 independent exchanges, with more subscribers than the Bell companies, has made the use of the word ridiculous. However, while making due allowance for what after all is not worse oratory and invective than is thrown around at every political election, one turns with a sense of relief to the excellent paper of Mr. Stanton, and it is felt that if the Association management would but engage more of these for its conventions, it would the sooner reach the dignity and the influence that await it. The telephone art to-day belongs to the people who give the best service for the least money. Mr. Stanton laid emphasis on questions of tariff, on improvements in equipment, on features of technical management, and discussed with great ability the three leading problems that confront Bell and independent exchanges alike, and he was not afraid to speak words of praise for "measured service" as scientific, or to insist that in order to give good service telephone companies must at least charge enough to pay their help fairly and maintain their apparatus in efficiency.

THE INSTITUTE MEETING.

Those who contend that it is well for a convention such as that of the American Institute of Electrical Engineers to get away from large cities, will at least find in the brilliant success of the Great Barrington meeting some support of their arguments. At first it seemed strange to many that a leading national technical body should go to a quiet and minute place in the Berkshire Hills, but it soon proved that while the associations with the place were a strong justification, the heartiness of the welcome and the readiness with which the members turned out were an even better evidence of the wisdom that dictated the choice. Once in a while the Institute will have to favor the great cities, but it is likely that such places as Saratoga, Old Point Comfort, Colorado Springs, Geneva Lake, Mackinac, etc., are apt in the future to be considered with a favor altogether disproportionate to their size. There are fewer outside distractions; there is closer attention to the business in hand, and the courtesies extended are always of a sensible, simple and cultivated kind. Anything more idyllic and acceptable than the hospitalities at Great Barrington and Pittsfield last week it would be difficult to imagine, and the sentiment as to the delightful time spent among those peaceful New England hills, from which came such men as the Fields, the Popes, Sprague, Stanley and others famous in electrical arts and history, was as enthusiastic as it was universal.

ELECTRIC RAILWAY SYSTEMS FOR HEAVY SERVICE.

During the Great Barrington discussion on the application of electricity to heavy railway service, Mr. H. Ward Leonard and Mr. Bion J. Arnold gave the outlines of systems for this purpose which they have respectively devised, and which will soon be tested on a practical scale. The system of Mr. Leonard was in its main outlines described in an Institute paper some years ago, but since then it has been improved in detail, and a complete system of multiple-unit control added. Its salient principle is motor control by variable voltage, employing the method which has been so successfully applied to warship turrets and to elevator and machine-tool operation. Briefly, the system includes the use of single-phase, high-voltage transmission, a single-phase motor driving a direct-current generator which supplies the car motors, the field of the generator being rheostatically controlled to give at the motor terminals any voltage from zero to a maximum. Part of the system consists of an extremely simple method of multiple control, employing merely rheostats in the generator field circuit, thus involving a negligible loss of energy in control. The objection urged against this system has been with respect to the expense, the weight and the space occupied; its advantage otherwise, particularly with respect to heavy work, having been generally conceded. That the above objections may have been overestimated would appear to be a fair infrence from the fact that the Oerlikon works have taken up the system, and are now building a 44-ton locomotive, to be operated from a 15,000-volt transmission line.

While it was quite well known that Mr. Arnold is about to equip with a single-phase motor system a 60-mile Western road, 20 miles of which are now nearly completed, the startling nature of the innovation was not surmised, and his announcement at Great Barrington of its general details formed the sensation of the meeting. The system, in fact, is highly original, both in principle and in details, and if the practical test, soon to be made, should prove successful, it is not too much to say that the matter of long-distance and heavy service railways will pass at a bound from the stage of discussion to that of practical realization. Briefly stated, the system consists in the combination of a single-phase motor having a revolvable stator and rotor, with compressed air engines and air storage, one engine being connected with the stator and the other engine with the rotor in opposite relation. Normally, the motor is always connected to line, and either the rotor or stator, or both, is always in motion. Assuming that the car is at rest, the stator runs at synchronous speed, compressing air for storage. To start, the stator-compressing engine is throttled, whereupon, since the synchronous relation between the stator and rotor must be maintained, the latter begins to rotate, thereby propelling the car. As the stator engine is further throttled, the rotor speed increases correspondingly, until finally, when the stator is brought to rest, the rotor has synchronous speed. Should it be desired to attain a higher speed than that corresponding to synchronism, the stator is by its engine revolved in the same direction as the rotor; and if in starting a torque higher than that of the motor proper is required, the engine of the rotor is brought into action. Further important details relate to the methods of retardation, and restoring energy to the line. Should the car pass through towns where it would be inadvisable to install the high-tension conductor, or be used for switching purposes, it may be propelled by the engines driven from the compressed air storage. The system embodies a number of other interesting features, such as the method of control, both simple and multiple-unit, the incidental use of electromagnetic clutches whereby either the rotor or stator or both may be uncoupled from the wheels when desired to compress air alone, the operations for ascending or descending grades at maximum efficiency and at any given speed, etc.

It will be noted that the method of Mr. Arnold, if successful, would convert the single-phase motor, which has thus far been handicapped by its inflexibility with respect to speed, into a means for attaining a flexibility of speed and torque superior to that possessed by any polyphase motor system yet proposed, and even exceeding in these respects the capabilities of the much-vaunted direct-current railway motor. Moreover, the system would appear to involve a high efficiency, for not only does the motor work at all times at maximum efficiency, but a portion of the energy of retardation and that now wasted in control resistance is saved, and practically a constant load is maintained on the power station. It is interesting to note that all of the control operations are mechanical, the electrical circuits not being subject to manipulation; and that the said operations are all automatically effected beyond the handling, as in present systems, of a controller lever by the motorman. The Great Barrington announcements come almost simultaneously with the notice of a new manufacturing combination about to enter the railway field with the Ganz system, and the situation with respect to long-distance and heavy-service electric traction has thus of a sudden assumed an unexpectedly bright aspect. For the credit of the American electrical engineering profession, we sincerely hope that a goodly portion of the promise held out will soon have fulfillment.

NEW ELECTRICAL MEASURING INSTRUMENTS.

No less than three new measuring instruments were described last week among the convention papers of the American Institute of Electrical Engineers. These instruments are not novel in their principle, being constructed on plans already known; but their utility resides in the details, either of construction or application, whereby their novelty becomes apparent. One of these instruments is the electrostatic wattmeter, described in the paper by Mr. Miles Walker. The principle of this instrument has long been known in connection with the quadrant electrometer, of which it is a linear descendant; but there are various interesting details in construction which appear to make this new apparatus not only less expensive, but also more convenient for special purposes than the quadrant electrometer. It is well known that the torque on the needle of a quadrant electrometer is proportional to the square of the voltage between the attracting quadrants and the needle. If the opposite pairs of quadrants have a small potential difference between them, such as that due to a drop of potential established by a current through a non-inductive resistance, the torque on the needle will be very small, unless the needle is maintained at a considerable voltage from the quadrants. In the latter case, although the torque may be ample to secure a good deflection, this deflection is not proportional to the potential difference between quadrants, or to any simple power thereof; but involves an extra term.

The paper referred to shows that when the potential of the needle is midway between the potentials of the quadrant pairs, this extra term vanishes, and the torque on the needle becomes simply proportional to the potential difference between the quadrant pairs, and also to the potential difference between their mean and the needle. Various ingenious devices are described for obtaining this desired symmetry between the three potentials, under the conditions that apply to commercial measurements. One of these measurements is of the power supplied to condensers or dielectrics, such as those of insulated electric machinery under high alternating voltages, and with a very small power factor. Another is of the power delivered to any high-pressure alternating-current apparatus, such as a synchronous motor. For pressures up to ten kilovolts, the minimum distance between quadrants and needle is recommended as one inch, while the needle is deprived of all sharp edges, and the edges are replaced by cylindrical contours of one-eighth inch radius. Under these

conditions the electrometer is capable of replacing a large quantity of complicated measuring apparatus.

The curve-tracing instrument of Prof. Owens is another ingenious instrument, described in a convention paper. The instrument does not trace curves, but enables curves to be traced conveniently by the observer. It is an electrodynamometer having one suspended and two fixed coils. The cyclically varying or alternating current to be plotted is sent through one of the fixed coils, and, in successive cycles, a synchronous revolving contact-maker permits a feeble direct current into the movable coil for a brief interval depending on the breadth of the contact-maker surfaces. These cyclic current impulses would naturally tend to displace the movable coil of the instrument in one direction or the other, to an extent depending on the magnitude of the alternating current in the fixed coil at the instants of contact. Instead, however, of attempting to obtain a measured deflection of the movable coil, the device is adopted of sending a direct current through the second fixed coil, and adjusting this current until no deflection is obtained, in which event the strength of the direct current is either equal to or a known fraction of the momentary value of the alternating current at that point in the cycle. The contact-maker is, therefore, carried step-by-step through a cycle, and the direct current in the fixed coil, which by adjustment cancels the effect of the alternating current, is correspondingly recorded and plotted. This gives a convenient null method of measuring a cyclically varying current through a dynamometer.

HEAVY ELECTRIC RAILROADING.

The Institute meeting was noteworthy for a group of railway papers of no little importance. Two of them, by Arnold and by Arnold and Potter, rationally belong together, and constitute, on the whole, the most important discussion of large electric railway work that it has been our fortune to see for many a day. The work bearing on the change of motive power at the New York Central terminus is by far the most thorough experimental investigation of the important questions concerned that has yet been made. And yet, well as the work was done, the investigation was, through no fault of Mr. Arnold, narrow in its scope. It dealt not with the large problem of general treatment of the entrance to a great city, but with the single phase of it involved in changing the motive power near the terminus. This is not at all the same thing, for it merely has to do with a change of apparatus—electric motive power instead of electric railroading. Within the scope of the investigation set before him, Mr. Arnold did an exhaustive piece of work of very great value to the engineering profession. Beginning with a thorough investigation of the load, the whole question of the replacement of steam by electric locomotives was overhauled and the matter of costs was worked out for every set of conditions that seemed at all worthy of consideration. The net result was what one might reasonably have expected, a small saving in the use of electric power, amounting to approximately two per cent. of the total cost per locomotive mile, including all fixed charges. The adoption of anything but the most carefully considered and economical system would have turned the balance the other way. To tell the unvarnished truth, the problem placed by the New York Central officials before Mr. Arnold was one in which all the conditions were so unfavorable for electric traction as could have been devised. There was no freedom of action allowed—it was the simple substitution of electric for steam locomotives in an enormous terminal yard. That electric power could show any saving whatever, even on paper, is the strongest possible proof of its importance in heavy railway work. The bloody record of the tunnel demands the abolition of the steam locomotive, irrespective of expense, and at anywhere nearly equal costs of operation. The New York Central management evidently realizes this, and is to be commended for the effort it is making in the right direction, as revealed in Mr. Arnold's paper.

To the engineer the most interesting part of the Arnold paper is a table, in which the costs of operating the proposed system by various methods to the number of a dozen, is carefully worked out. Mr. Arnold is well-known as a believer in alternating-current traction, but in this instance he very wisely confined himself to direct-current methods, as being the only ones so far developed as to permit immediate installation with existing apparatus. His tabulated results are a beautiful demonstration of the economic importance of simplicity. A straight 600-volt distribution from a single centrally located power house was decidedly the cheapest method of attaining the desired result. Then came the combined alternating and direct-current power house near one end of the line, with a transmission to a substation with rotaries near the other end. Next in order was a 600-volt direct-current station and a pair of battery substations, and a combined station with a single substation with rotaries plus a battery reserve at each point, which was the plan recommended. This was a little more than 10 per cent. less economical than the simple 600-volt distribution, but had a somewhat greater factor of safety, and did not demand a power house at a point where it would have been, perhaps, unattainable. The only surprising thing in the list is the remarkably good showing made by the plan with battery substations. In this connection it must be remembered that so long as the motors are of restricted voltage, there will be a very heavy charge for the working conductors not to be lessened by any scheme that does not increase the number of substations. Rotaries and batteries are of economic value only as they enable this to be easily done.

The paper by Arnold and Potter is a careful study of the relative capabilities of steam locomotives and electric motor cars for securing the acceleration necessary in heavy and fast suburban service. The comparison was made with a powerful consolidated engine for this class of work, and hence the results have a value that they would lack had the test been made with an ordinary locomotive not specialized with acceleration in view. As might fairly have been predicted, the motor cars equipped with motors of ample power and with all their weight upon driving wheels have made a much better showing than the locomotive in accelerating trains of equal weight. Not only did the motors give a greater maximum drawbar pull, but they could keep up the work, giving quicker acceleration, and hence a lower maximum speed for the same schedule than in the case of the locomotive. The latter tended to lose steam pressure rapidly under continued effort—only aonther proof of the disadvantage of carrying its own power station. Electrical engineers have long been cognizant of the advantage of electric traction in such work, but positive figures from the latest types of suburban service locomotives have until now been lacking. So far as energy and cost of energy is concerned, electric traction has a manifest advantage, and we are sorry that in opening up the study of conditions at the New York Central terminus, these conditions were not so broad as to take into account the transformation of the entire suburban service as part of the general problem. It does not follow from the experience of railroad men in arranging terminal facilities for traffic along steam railway lines, that the same methods which there prove best will still be preferable when electric traction is adopted for the whole work. There is a certain result to be attained in each case, but an electric suburban service offers some material advantages of its own, and when combined with the general terminal service leads to new economic conditions there. Still, it is no small thing to have made the investigations merely on the terminal part of the problem, and the results are of very great value as a guide in work in the larger field. The locomotive is no mean rival, and even a small victory is well won.

Charles T. Child.

We regret to announce the death of Mr. Charles Tripler Child, technical editor of the *Electrical Review*, which occurred June 25, at Gleasondale, Mass. Mr. Child was taken ill several weeks ago, and upon the symptoms becoming serious was removed from his home, at Montclair, N. J., to the residence of his wife's father, the Rev. J. R. Cushing, where he died, the immediate cause of death being typhoid fever.

Of a sympathetic and social nature, Mr. Child endeared himself to hosts of friends, and was one of the most popular and highly-esteemed members of the electrical fraternity in general. Through his brilliant gifts of mind and literary expression he was widely known as a lucid exponent of engineering science, to which also he made several contributions of an original character. As an engineer and designer, Mr. Child also had an enviable record. Many will mourn in him a warm-hearted and sympathetic friend and a genial companion, whose brilliancy of mind and conversation enlivened every occasion. Through his death the world is poorer by a brilliant technical writer, a cultured gentleman and a kindly spirit.

Mr. Child was born in Richmond, Va., November 1, 1867. His education was conducted by a private tutor until his entrance at Richmond College, in 1880. Leaving this college in 1885 he entered the Johns Hopkins University as a special graduate student in physics and mathematics under Professors Rowland, Clark and

Franklin. The next year he was a member of the newly organized class in electricity, under Dr. Louis Duncan, and had also a course in chemistry.

In the summer of 1887 he entered the service of the Sprague Electric Motor Company, in New York City, and in the autumn of the same year he was in charge of the wiring and equipment of the cars for the Richmond Railway and Electric Company's historical railway line.

Desiring to acquire experience in the operation of electric lighting apparatus, he went, early in 1888, to Kansas City, Mo., and entered the service of the local electric light station as a laborer, becoming finally assistant to the superintendent. After a year spent in acquiring this experience he returned to New York, where he became office engineer for the company building electric railways under the patents of Mr. Leo Daft. In this connection he made the specifications and supervised the construction of twelve electric railway installations, took part in the experimental work in heavy electric traction conducted on the elevated railway system of New York, and in the operation of the first storage battery traction lines in the United States, at Toledo, Ohio; Newark, N. J., and in Madison Avenue, New York.

Upon the liquidation of this company, in 1891, he went to Richmond, Va., and formed, with a number of local parties, a manufacturing company for the construction of dynamo machines and motors, and the construction and operation of a water-power electric light and power supply station. This concern did an excellent business and was, the next year, consolidated with other electric lighting and railway enterprises in Richmond. He designed and built for this company many types of direct and alternating-current apparatus, including the lighting alternators used in its central station service.

Going to Washington in 1892, he became aid-in-charge of the United States Astro-physical Observatory of the Smithsonian Institution, wherein was conducted, under his supervision, the elaborate researches of Professor S. P. Langley, on the infra-red solar spectrum, employing the bolometer and other electrical apparatus. Much of this he designed and constructed.

Leaving this service the next year to conduct experimental work for the development of certain of his patents on electrical apparatus, he was later recalled to Washington to reorganize the research work of the Observatory. This being accomplished, he returned, in 1895, to his home at Richmond, Va., and opened an office for the practice of consulting electrical engineer. He designed the plant and equipment of the Richmond Traction Company and the telephone exchange of the Richmond Telephone Company, then the largest independent telephone exchange in the world.

In 1897 he was tendered editorial charge of the *Electrical World*, of New York, a position resigned some two years later for a similar connection with the *Engineering Magazine*. In 1899 he became technical editor of the *Electrical Review*, which position he occupied at the time of his death.

The honorary degree of B. Sc. was given Mr. Child by his *alma mater*, Richmond College, in 1893. He was a member of the American Institute of Electrical Engineers and of the several other technical and scientific societies. Mr. Child was married, Nov. 30, 1899, to Miss Bertha Cushing. Mrs. Child, a daughter and twin sons survive him.

Modern Banking by Telephone.

A novel device for avoiding the imposition of New York Clearing-house charges for the collection of country checks has been adopted by two or three trust companies located in suburban territory. The practice, as reported by the New York *Evening Post*, applies to very profitable business and involves giving a customer credit at a New York bank for funds deposited at some New Jersey point. As admitted by a director of one out-of-town trust company, the procedure follows this order: A man deposits $100,000 in a trust company located 30 miles from New York. On opening his account, he is given two check books, one on the out-of-town trust company, the other on a New York bank with whom he has no direct relation. The bank is immediately advised to honor the checks that he draws, charging their amount daily to the trust company's account. This done, the man checks at pleasure upon his New Jersey funds, the New York bank notifying the New Jersey trust company each night by telephone how the account stands.

This, in short, is the latest development of "banking by telephone." Its conveniences, as stated by the banker himself, are as follows: "You see the Clearing-house people cannot reach us, for we do not cash New Jersey checks at par, only items drawn on one New York depositary. The system was devised to relieve our customers of the necessity of paying the one-tenth of one per cent. charge exacted by Clearing-house banks for collecting our checks, and while it may violate the spirit of the rules, it comes within the letter of the law so far as the New York bank is concerned. Then, too, there is very little risk about the matter, for if our customer draws too heavily for the New York bank to honor without question, five minutes at the telephone will straighten out all difficulties. Of course, it would not be practicable to extend such facilities to very small depositors, but the man whose account is worth having need never be at a disadvantage so far as paying the out-of-town check collection rebate is concerned. We can fix him up all right."

Another incident, which happened only a few days ago, shows the same practice in another light: A man who kept a large account with a New Jersey trust company had occasion to strengthen his balance at a New York bank. He wanted to certify for a large amount, and fell some $20,000 short of the sum required. To cash a New Jersey check for that sum meant paying $20 in collection charges, so, explaining matters to an officer of the bank, he asked to have a credit for $20,000 transferred from the New Jersey account to his own, giving the bank a check to protect it. The officer winked, said he thought it could be arranged, and certified the customer's check for $20,000 more than his account showed, making good the difference out of the trust company's funds.

Telephone Exchange at Dubuque, Iowa.

In November, 1900, a company of influential business men of Dubuque, Iowa, headed by Mr. Victor H. Stevens, started the Dubuque Telephone Company, in order to secure a good telephone service at reasonable rates. It began in a small way with a single section of a 100-drop switchboard, but so rapidly did the company grow in favor that it was obliged to increase this, section by section, until it had seven hundred subscribers and calls for many more instruments. In order to anticipate the future requirements it was decided to purchase a multiple board, and in May, 1901, a 900-drop standard Ericsson multiple board, as shown in the accompanying illustration, was purchased. While the service had always been good, this new board enabled the exchange to make more rapid connections and give better service in general, and the result was that the board had been installed but a short time when another section was added to accommodate the increasing patronage.

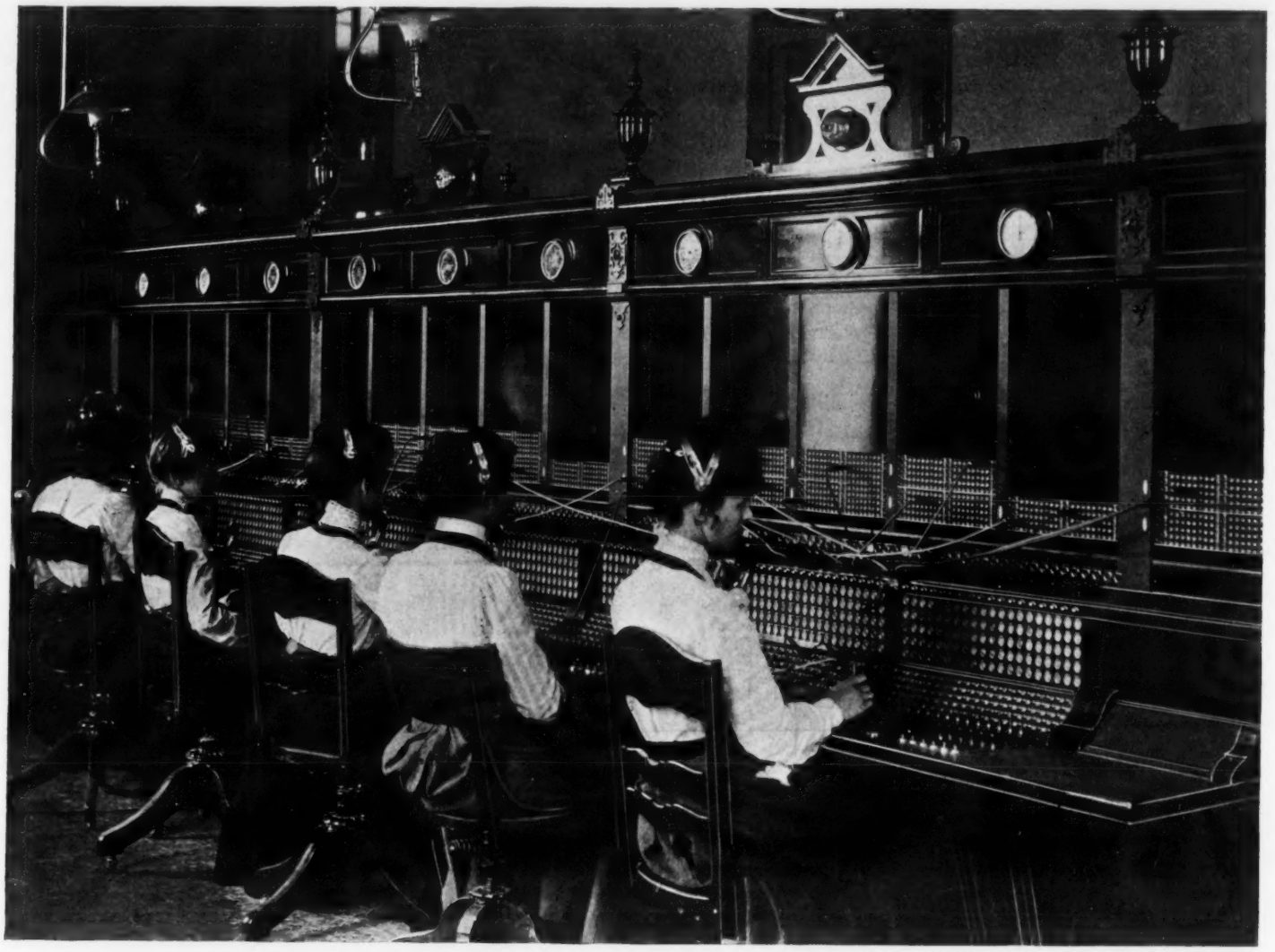
From the present indications this section will soon be filled and another one will be necessary, as the pepole of Dubuque realize that the intentions of the company are to give perfect service at a minimum charge, and hence are responding freely with their subscriptions. The Ericsson apparatus is used exclusively in connection with this exchange and the results have been most satisfactory, owing to the small amount of repairs necessary to maintain the efficiency of the exchange.

In some of the banks, hotels and private houses complete imported telephones have been placed. These are considered by the users to be very much handsomer in appearance than the ordinary telephone, and serve both as an ornament and an article of utility. The switchboard was manufactured at the Ericsson factory in Stockholm, Sweden.

The exchange has a capacity of 3,000 subscribers, and in connection with the Standard and Interstate Telephone Companies, all of which are under Mr. Stevens' management, bids fair to become the nucleus of a powerful telephone community.

It may be of interest to know of the low rates made by the Dubuque Telephone Company, which are as follows:

Business, individual circuit, per year	$24.00
Residence, individual circuit, per year	15.00
Business, party line circuit, per year	18.00
Residence, party line circuit, per year	12.00
Long distance, or desk sets, per year additional	3.00



GENERAL VIEW OF SWITCHBOARD IN DUBUQUE EXCHANGE.

Coronation Honors.

From the sick-bed King Edward sent the order on Wednesday that the list of honors prepared for the coronation should be published at once. Several of those favored are names well known in scientific circles. An "Order of Merit" has been instituted, and among those honored in this connection are Lord Kelvin, who stands in the list with such names as Earl Roberts and General Kitchener. Lord Kelvin was also appointed a Privy Councilor. Knighthood was conferred on Dr. Oliver Lodge, and Prof. Ramsey was named a Knight Companion of the Order of Bath. It was stated that the newly-formed Order of Merit will include distinguished foreigners as honorary members.

Postal Telegraph and P. R. R,

The directors of the Pennsylvania Railroad Company on Wednesday authorized the signing of a contract with the Postal Telegraph Company to cover a period of 15 years. It is said that the Postal Telegraph Company is to pay the Pennsylvania Company $70,000 annually for the privileges that it receives, and percentage on its commercial business. The railroad company is to furnish poles to the telegraph company for the extension of its lines, and is to be limited to 100,000 free messages, which is about 50,000 less than the number used.

Plans for Laying Pacific Cables.

The project for a subsidized American Pacific cable is killed for at least the present session of Congress, as noted briefly in these columns last week. On June 10, Mr. Dalzell (Pa.) in the House presented the special order for the consideration of the Corliss Pacific Cable bill. By its terms four hours were to be allowed for general debate, and any Pacific cable proposition was made germane to it. Mr. Dalzell called attention to the fact that by the terms of the rule the whole question of the Pacific cable would be before the House.

Mr. Adamson (Ga.) protested against the building of a cable by the Government. He argued that the private company which had planned to lay a cable to the Philippines should be allowed to do so without let or hindrance. He protested against the Government entering into a conflict with capital and labor engaged in private enterprises. The Government had the privilege of seizing and using the Commercial Company's cable after it was built. Mr. Richardson (Ala.) argued that there was no necessity for the construction of a government cable when private enterprise already had begun the construction under terms advantageous to the Government.

Mr. Dalzell announced that he was opposed to the construction of a government cable. The experience of foreign countries as regards both railroads and telegraphs was against it. Nor did he favor the proposition of the Commercial Pacific Cable Company, of which Mr. Mackay was the head. His information, he said, was that English capital was behind that company. Mr. Mackay might be a loyal American, but it was many years since he had lived in America. He belonged to that class of Americans who were denominated "expatriated Americans."

Mr. Corliss said that the bill provided for a government cable uniting our islands with the American continent. By its terms the cables shall be American made, laid by American ships, and managed by the American Government. He placed the cost of construction at not exceeding $10,000,000, and the cost of operation at $400,000 per annum.

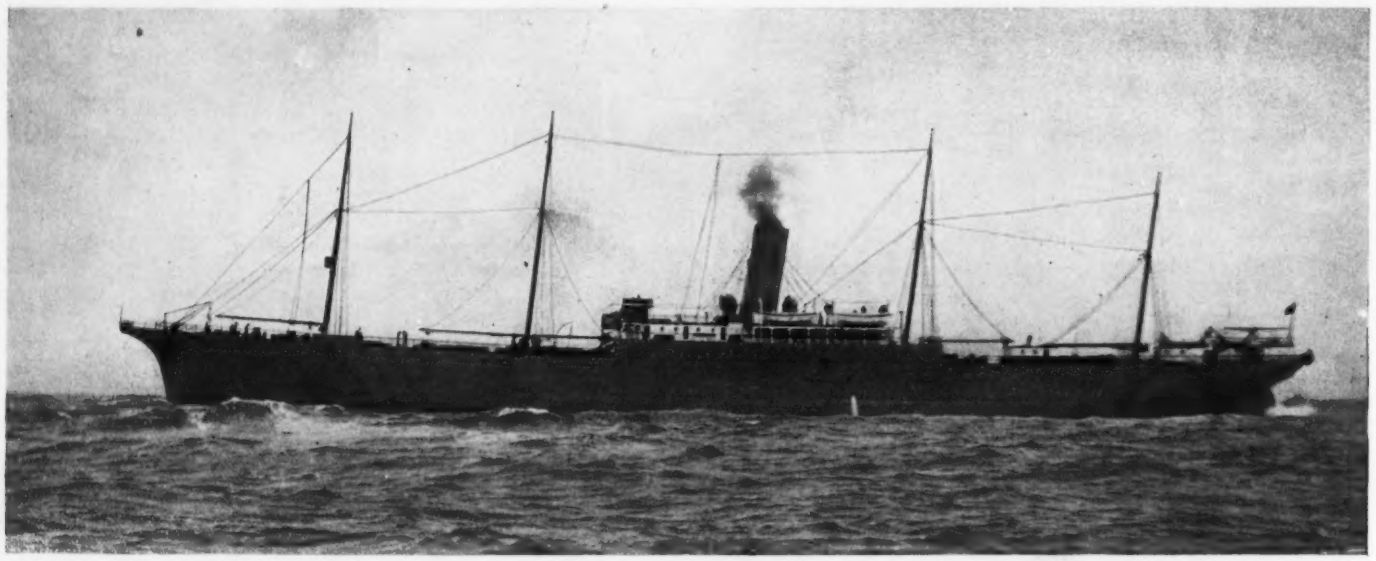
While this debate was going on, the Commercial Pacific Cable Company announced that 1,000 miles of its cable have been laid between San Francisco and Honolulu. Mr. Cannon, also in the House, chairman of the Appropriation Committee, called a halt on further public expenditures. He stated that estimates for next year made receipts $639,000,000, while appropriations already made by this Congress for next year exceeded estimated revenues by $52,000,000. He opposed vigorously any appropriation for any Isthmian Canal or cable to the Philippines, and warned the House that the present surplus in the treasury, $175,000,000, would be soon exhausted if further appropriations be made on the scale that has prevailed heretofore.

On June 11 the House went into Committee of the Whole, and resumed the debate upon the Corliss Pacific cable bill, when Mr. Richardson (Ala.) took the floor in opposition to the bill. He called attention to the speech of Mr. Cannon, in which the latter showed that the appropriations for the next fiscal year already exceeded the estimated revenues by $51,000,000, and urged this as the first reason why the Government should not enter upon the expensive work of building a cable to the Philippines. He referred to the possibilities in the development of wireless telegraphy, and argued that it would be unwise, on the threshold of the development of the new system, for the Government to expend $15,000,000 or $20,000,000 for a submarine cable which might be valueless in a few years.

Mr. Corliss asked if the Attorney General had not refused to consider the contract which the Commercial Cable Company had offered to make.

Mr. Richardson replied that the Attorney General and other Government officials had declined to interfere in the matter, and that the company was proceeding to lay the cable under the Post Roads act. In explanation of the reason the cable was being built in England, he said that the English company were building a cable which they guaranteed for two years. No other company would guarantee a cable for 30 days, he said. He read a letter from John W. Mackay, of the Commercial Company, addressed to Mr. Hepburn, chairman of the committee, and says:

"My cable engineer, Mr. Cuttriss, through your kind offices and the courtesy of Mr. Moody, the Secretary of the Navy, and of Admiral Bradford, has been allowed to examine the charts of soundings on file in the Navy Department, showing that it is feasible to land a submarine cable on the Island of Guam, in the Pacific Ocean. Mr. Cuttriss has just telegraphed me that these soundings show that such a landing is practicable. This removes the only doubt as to the feasibility of an all-American cable from San Francisco to Manila, and I write this letter to you to state positively that the submarine cable, which the Commercial Pacific Cable Company has agreed to construct, lay and operate from San Francisco to Manila, will be an all-American cable, and will not touch on any foreign island or territory whatsoever. I give you my personal assurance to that effect. The first section of this cable will be in operation in November, 1902, and we expect to be able to arrange for the remaining sections to be completed and opened for traffic during the year 1904."



NEW CABLESHIP "COLONIA."

Mr. Newlands (Nev.) paid a high tribute to Mr. Mackay. He said Mr. Mackay had entered a contest on the sea against the great Atlantic cable monopoly, and on land against the Gould telegraph system. He also had built the Haiti cable, the control of which was surrendered to the United States during the Spanish war.

Mr. Loud (Calif.) opposed the bill on the ground that Government operation of telegraph systems in Europe was not a success. Since 1872 England had lost about $35,000,000 in the operation of her telegraph system. He concluded by expressing the hope that the House would kill all the bills and leave the Pacific Ocean open to any company which cared to undertake the laying of a cable. (Applause.)

Mr. Adamson (Ga.) moved to strike out the enacting clause of the bill. To prove that the Commercial Cable Company was proceeding with the work of constructing the cable it proposed to lay, he read a cablegram from London, signed by G. G. Ward, vice-presi-

dent, certifying that 1,065 nautical miles of the cable to be laid between San Francisco and Honolulu had been completed, and that the work was proceeding at the rate of 26 miles a day. The cablegram said that a steamer would leave with the cable for San Francisco before August 1.

Mr. Adamson's motion to strike out the enacting clause on a yea and nay vote was carried 116 to 77. The measure was therefore lost.

In this connection we are able to illustrate the new cable ship "Colonia," just built and engined by Wigham, Richardson & Co., of Newcastle-on-Tyne, for the Telegraph Construction and Maintenance Company, Limited, of London, whose mission it is to lay the British cable. The conjunction of events gives unusual interest to her successful trial trips now made prior to her departure. The vessel is 500 feet in length, with beam of 56 feet, and is designed to carry close upon 10,000 tons dead weight. When loaded she is to steam 11½ knots. The length of cable that she can carry is about 4,000 miles, which is a greater length than could be put on board the "Great Eastern" when she was engaged in her cable-laying expeditions. From the photograph which we herewith reproduce, it will be seen that the builders have designed an elegant looking craft in spite of the special conditions which had to be fulfilled, and in this respect the "Colonia" is a pleasing contrast to cableships afloat. The spar deck of the ship is of teak, and is flush right fore and aft, making a magnificent and spacious promenade. Amidships is accommodation for the officers and numerous electrical experts. There are also bathrooms, large galley, butchery, bakery, and on the deck below a refrigerating chamber. Adjoining the cabins is a spacious dining saloon, panelled in oak and fitted with great elegance even to the minutest detail. On the bridge deck above are the apartments of the captain, being a suite of three rooms. Next to these is a chart room of ample proportions, and above it is the navigating bridge and boat deck.

In the afterpart of the vessel on the spar deck are two houses of special interest to electricians, one of them being the test room, and the other the drum room. These have a very complete installation of galvanometers and other testing instruments, together with a quantity of the special appliances, by means of which all the calculations are made as to the amount of cable paid out, the strain on it, and its electrical resistance. The aftermost deckhouse is occupied by the powerful steering apparatus, which is a combined hydraulic and steam-steering engine, actuated by a telemotor on the flying bridge.

The vessel is lighted throughout with electricity, and as much of her work is in tropical seas, special attention has been given to ventilation. On the main deck is accommodation for the crew, the cable hands and the stewards, and there is also a well-aired hospital. Amidships will be found an engineer's repairing shop with a lathe, drills and several other machines.

Below the main deck are the four huge cable tanks, two of them being forward of the bridge and two aft. The propelling machinery consists of two sets of triple-expansion engines, working at a pressure of 190 lbs. per square inch. The outfit of pumps, feed-water heaters, evaporators, filters and other auxiliary machinery is exceptionally complete.

As soon as the cables have been loaded, the "Colonia" will proceed on her long journey, via the Suez Canal, to Vancouver. She will then lay the cable from that point to Fanning Island, the little patch of dry land in mid-Pacific. The cable from Fanning Island, Fiji, New Zealand and Australia has already been laid, so that as soon as the "Colonia" has accomplished her work in hand, the British nation will have a complete circle round the world of telegraphic cables, all of which lie between points of British territory. This is a possession of which no other nation can boast.

Wireless Telegraphy for Alaska.

Gen. Greely, chief signal officer, has contracted with the Marconi Wireless Telegraph Company for the erection of two wireless telegraph stations, connecting Fort Gibbon, Alaska, with Bates Rapids, on the Tananap, a distance of 165 miles in an air line. The company undertakes to have the stations in working order by the 1st of October next. Gen. Greely already has an overland wire from Nome City to Fort Gibbon, and with other existing lines in Alaska this wireless system will complete a circuit from Behring Sea down to the south coast. The company's undertaking is to supply a system that shall work every day without interruption, else the Government will not be under any expense.

The Present and Future Status of Wireless Telephony.

BY A. FREDERICK COLLINS.

It is a noteworthy fact that as quickly as a principle has been demonstrated to have a commercial value, a large number of workers is at once attached to it, and with their bended energies a rapid and broader development naturally results.

As an instance, the successful employment of wireless telegraphy has led many experimenters and inventors into the field of action, but who, a few years ago, would have hardly dreamed of the great possibilities Hertz's experiments offered. Wireless telephony stands in practically the same position that wireless telegraphy did prior to 1897, for the reason that its great value is seen through a glass darkly, since it has not been tried by the crucial test of commercial usage. A a consequence there are very few persons engaged in solving the riddle of making it an instrument of wide range and indispensable utility. This may seem a little strange considering that many who devote their lives to original investigation, as well as practical men in the course of routine engineering, have been led to the very threshold of wireless telephony in their researches in induction, electrolytic conduction, light and Hertzian wave and other phenomena of forces acting at a distance without the customary connecting medium in the form of a metal conductor; but with very few exceptions have the experiments been carried further with the idea in mind to transmit articulate speech without wires. In England, Sir William Preece has made an exhaustive study of both the inductive and conductive method of telephoning without wires. In France, M. Ducretet made some clever experiments very recently, using the catacombs for one of the terminals of the grounded wire, whilst the other rested on the surface of the earth; M. Machie is at present making some tests in France, and in this country, the writer has made experiments with the result that the distance to which speech could be transmitted was sufficiently great, and the voice clear enough to say that the instruments were of commercial worth.

This brings up the question of what really constitutes a commercial wireless telephone. There are a class who assume that a wireless telephone should be in such a perfected condition when placed upon the market that it would be possible to replace the ordinary telephone by it; this is, however, an idealistic view of the matter. On the other hand, a wireless telephone having a carrying capacity of a fourth of a mile would fufill certain requirements up to that distance, and good instruments for even this distance would have a ready market. But with a carrying capacity of from one to five miles, the wireless telephone would at once spring into popularity upon its practical value being shown.

There are many instances where an ordinary telephone cannot be employed. As an illustration, let me cite a few cases. (a) Two families lived only 1,500 feet apart, and where telephones costing $25 per pair would have answered the purpose, but owing to a railroad operating the adjoining properties, permission could not be obtained to stretch the wires; as an experiment the wireless telephone was tried, and with success. (b) Another case was in the Thousand Islands, where a cable was laid from an island to the main land, at a cost of $2,000; here again a wireless telephone could have served the purpose at a cost not exceeding $200. (c) A third case is in Narbeth, where the borough officials will not permit the Bell Telephone Company to erect poles; two physicians have had telephones in their residences for nearly a year, hoping that the Bell people would effect connection with their lines, one-fourth and one-half mile away. The contention between the Bell and borough was a matter of one narrow street. This distance could have been easily bridged by means of a wireless telephone; in fact, communication was established between one of the residences and the writer's laboratory, where three streets intersected the line of wave propagation, but as it took place under the surface of the earth, no one objected to it.

But the most useful sphere of the wireless telephone, and the one which the writer has ever advocated, is its application to vessels in harbors. The wireless telegraph is pre-eminently a long-distance system, but used in harbors experienced operators would be required to transmit and interpret the messages after the captains had given them. The wireless telegraph is at present too complicated and too uncertain where thousands of lives depend absolutely upon the accuracy of the transmitted signals. Here the wireless telephone is needed, for the wireless telegraph is just as inapplicable for short

range work as a wire telegraph would be for ordinary telephonic purposes. The wireless telephone is a first-hand instrument; it is simple, reliable, and it may be applied to any vessel at a comparatively small cost.

Just recently two accidents occured in the North River because of a misunderstood signal. The first was when the yacht "Aileen" rammed a ferryboat, and the second was a collision between two ferryboats. In a fog, where there are a dozen ferryboats with whistles shrieking continuously, the pilot, not having a synchronized ear, hears all of them at once, and knows not whither he should turn his ship.

The steam whistle did very well immediately after Fulton had made steam navigation possible, and when there were only one or two vessels, but now, where there are a dozen in the same zone, and the speed is such that it makes a stranger's hair stand on end—not at his own wonders, as was said of Cornus, the magician—but at his own temerity in riding on vessels where, in broad daylight, the frightfully close proximity of the vessels under steam seems certain destruction, should not more modern appliances than a steam whistle be used in signalling? Even the blasé New Yorker, who of necessity becomes hardened to tunnel accidents and harbor collisions, must at times feel a little awed as he stands under the shadow of the steam whistle. The wireless telephone is the remedy. It may be argued that it is not synchronized either, but here the range may be extended or decreased at pleasure, and those a quarter or a half mile away may be excluded while orders are passing between the vessels nearest to hand. In other words, it would prove a conditional block signal system.

The future of wireless telephony is not, evidently, to eliminate the wire system, yet even stranger facts have come to pass in our time and generation; but excluding this optimistic view of the situation, it must be admitted that it would form a valuable adjunct to the efficient wire systems now in use.

The syntonization of wireless telephony is one of the knotty problems. It is this question that staggers the most sanguine; but if one had asked Prof. Bell, in 1876, how any two of 40,000 subscribers might be put into instant communication one with the other, he, doubtless, would have found it difficult to even picture in his mind's eye the modern central station switchboard.

It must be remembered that the wire telephone has had engaged in its improvement the brightest scientists, the most original investigators of the world for a period of over a quarter of a century, and this experience and application has brought the "toy" to one of the most potent factors of the commercial world. Would that a little of such applied energy could be put on the wireless telephone.

When a system is perfected for multiplexing ordinary telephonic messages, and the syntonization of wireless telephony is a fact, the combination of these two devices will produce a new service, wide-reaching and bringing the cost of installation down to a miuimum.

Galileo Ferraris Award.

The committee for the "Galileo Ferraris Award," instituted in 1898, and composed of the representatives of the executive committee for the General Italian Exhibition, held in Turin, in 1898, of the chamber of arts and commerce, of the Royal Academy of Science and of the Royal Industrial Museum in Turin, have decided to open an international competition for the award of said prize on the occasion of the unveiling of the monument to Ferraris, in Turin, in the latter half of the month of September next. The award is 15,000 lires ($3,000), together with the compound interest accumulated since the year 1899 up to the day of the award. It will be granted to the inventor of some practical application of electricity likely to lead to noteworthy progress. Competitors may submit either pamphlets, projects and drawings, or machines, apparatus and appliances relating to their invention. The jury, composed of the aforesaid committee, shall have full power to cause practical experiments to be made upon the inventions entered for competition, and upon the corresponding apparatus. Competitors are to file their application and deliver their credentials appertaining to their invention not later than 6 o'clock P. M., on the 15th of September, 1902, at the office of the secretary of the committee, care of the Administrative Committee on the First International Exhibition of Modern Decorative Art in the buildings of the Chamber of Commerce and Art, 28 Via Ospedale, Turin, Italy.

The Great Barrington Convention.

The nineteenth annual convention of the American Institute, held at Great Barrington, Mass., adjourned Saturday, June 21, after the most successful meeting in the history of the Institute. More than 250 members and guests were registered, and the most gratifying interest was manifested in the proceedings, both with respect to attendance at the meetings and in the discussion of papers. The social features of the convention were particularly agreeable, and very wisely had been so arranged as not to interfere in any manner with the main objects of the meeting.

At the session of Thursday morning a telegram was received from the Pacific Coast Transmission Association, in meeting assembled, sending greetings. The telegram also stated that the association had passed a resolution condemning the proposed underwriters' rule, which would limit overhead street voltage to 3,500 volts, which rule was pronounced unjustified and prejudicial to vested interests. Action of the Institute being requested by the association, the matter was referred to a committee with instructions that it report on the subject to the council.

A letter was also read from President-elect Chas. F. Scott, dated Berlin, Germany, sending greeting and expressing the hope that all would aid in making the coming Institute year as fruitful as the very successful present year under the administration of President Steinmetz.

During the discussion on Friday, Prof. Owens advocated holding, at Montreal next year, a joint meeting of the American and British Institutes of Electrical Engineers. After some discussion, a motion was carried that the British Institution be invited to take part in a joint meeting at some time in the future, to be mutually agreed upon —probably in 1894, during the St. Louis World's Fair.

THURSDAY'S SESSION.

The session of Thursday was opened by a paper of Mr. C. O. Mailloux, entitled "Notes on an Experiment with Single-Phase Alternators on Polyphase Circuits," an abstract of which appeared in our issue of last week. In this paper an account was given of successful experiments in operating two single-phase machines on a two-phase circuit, the phase relation being maintained by means of a rotary converter operated on the circuit.

Following the reading of his paper, Mr. Mailloux replied to several questions suggesting other methods of starting the system, saying that the conditions made more convenient the procedure actually followed; if, for example, the rotary were separately excited, the alternators could at once be thrown on. Mr. Steinmetz said that about 1894 he had experimented with single-phase alternators connected to a polyphase circuit. In one case three single-phase machines in closed series supplied three-phase currents to a circuit, the three legs of which were respectively connected between the alternators. He gave a remarkably simple graphical generalization as a criterion to apply in determining if a given arrangement of machines will prove a stable combination. A single-phase machine is represented by a straight line, a two-phase machines by two lines at right angles, and a three-phase machine by an equilateral triangle. If now any combination of these lines and figures forms what in statics is known as a stable figure, the corresponding combination of machines and circuits is possible. For example, three lines form a triangle which is a stable figure, and consequently three single-phase machines in closed series will supply a three-phase circuit. Again, four lines arranged as a square is an unstable figure, but if strengthened by two diagonals becomes stable; therefore, four single-phase machines can be used in combination with a two-phase machine to supply a two-phase circuit. The generalization may be extended to include also the use of synchronous motors and rotary converters in combination with single-phase generators.

In reply to a question, Mr. Mailloux said that a single-phase machine could be used in parallel with one or more phases of a polyphase machine, as, for example, to assist at the peak of a load; in reply to another question, he said that the rotary might be a two-phase machine on a two-phase circuit, or a three-phase machine run from a two-phase three-phase transformer—there being no difference in action involved.

Mr. Murphy, of Ottawa, said that the case described by Mr. Mailloux represents exactly the existing conditions of affairs at Ottawa, Ontario, if two-phase apparatus and a 2,200-volt line were substituted for the three-phase machines and 25,000-volt line shown.

Before the station, which was subsequently equipped with two-phase machines, was ready to run, a rotary converter was installed and operated from a single-phase generator at another point corresponding to the steam station of Mr. Mailloux. This converter was started up by current from a storage battery and one of its alternating-current circuits synchronized in the usual way (with a single-phase generator)—lamps being used for this purpose at first, and later on, when the Lincoln synchronizer was developed, these were replaced by the latter instrument. The rotary converter was used in this manner for about a month, and was called upon to do about two-thirds of its rated working capacity. During the past winter one of the single-phase generators of the Ottawa plant has been operated in parallel with one phase of the two two-phase machines, sufficient incandescent load being placed on one side of this combination as to keep the single-phase machine carrying the difference of load between the two phases. This method of operation has worked so satisfactorily that arrangements have been made to run the rotary converter from the two single-phase machines—only one of which was available when the rotary converter was used as a single-phaser—should it ever be necessary to shut down the two-phase station; the rotary will then keep the single-phase machines in proper phase relation. Mr. Murphy said that the fact that Mr. Mailloux has already accomplished this is a matter of considerable satisfaction to the engineers of the Ottawa plant.

Mr. Mailloux's paper was followed by the four railway papers on the programme, discussion being deferred until after all the papers had been presented. Abstracts of two of these papers appeared in our issue of last week, namely, those by Messrs. Arnold and Arnold and Potter. The paper by Mr. Arnold was by far the most prominent presented at the meeting, and of particular timely interest, on account of disclosing the plans for the electrical equipment of the New York Central metropolitan terminus. The joint paper of Messrs. Arnold and Potter gave an account of experiments to determine data for a comparison of steam and electric traction under certain conditions, and forms a contribution to electric railway literature of permanent value.

A STUDY OF THE HEATING OF RAILWAY MOTORS.

A paper with the above title, read by Mr. A. H. Armstrong, forms a valuable and much-needed contribution to electric railway literature. The paper is illustrated by 14 sets of curves, and as much of the text is in reference to these curves, the reader who wishes to follow closely the study of Mr. Armstrong is referred to the complete paper, in the *Transactions* of the Institute..

Mr. Armstrong prefaces the paper with the statement that as regards the tractive effort required to propel trains of one or two cars at speeds of 60 miles per hour or more, there is almost a complete lack of experimental data. Formulæ based upon tests of steam trains, made up of a number of heavy coaches, cannot be applied with any accuracy to the operation of single car units. A series of tests made by the General Electric Company on the Buffalo and Lockport tracks, with trains of different sizes, provides almost the only data upon which to base such calculations. These tests were carried up to speeds approaching 60 miles per hour, with ordinary steam railway coaches, hauled by a 38-ton electric locomotive, and are used as the basis of the calculations given in the paper.

The curves of the above test are given, and from these are deduced speed time-curves for certain cases considered. As the heating of a motor is the result of the average losses within it, the average losses and their distribution up to any moment of shutting off power must be determined. Such losses are shown in Fig. 1 for a 35-ton car equipment, the speed and ampere curves of which are given by the above-mentioned curves. The curves show that while there is a total average copper loss of 5,000 watts during acceleration upon resistance, the copper loss curve becomes flat in about 400 seconds at the value of 1,800 watts in the copper, with the motor constants chosen. As an equipment geared for a maximum speed of 60 miles per hour would hardly be used for an average run of less than 15,000 feet requiring power on for fully 160 seconds for its accomplishment, it will be seen that the acceleration losses play a comparatively unimportant part in very high speed work, so far as the motor heating is concerned. That this is not true of low-speed work is discussed elsewhere in the paper.

The following instructions are given for making a test: Suppose we take our motor equipment, place it upon a car and run it over a measured length of level track, keeping an accurate record of the current input and voltage per motor at each instant. Then let this sample run be repeated successively for a period of ten hours, or long enough for the motor temperatures to have reached their maximum, and we have the relation between energy lost in the motor and its temperature for a given set of conditions. Vary the length of the test run and repeat the ten-hour test, and we have another relation between temperature rise and energy loss for another set of conditions.

It may be urged that it is difficult to reproduce with any accuracy the sample run agreed upon, or that it is difficult to follow through and keep an accurate record of just what takes place in the

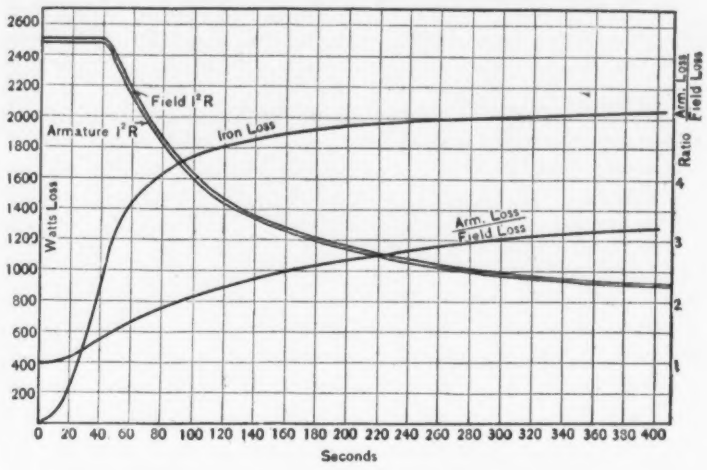


FIG. 1.—CURVES OF LOSSES FOR 35-TON CAR EQUIPMENT.

motor during its cycle of operation. If necessary, an automatic device for applying the current could be used, such as a motor to throw on the controller at a predetermined speed. Sufficiently good results can be obtained, however, by ordinary hand control with a trained operator, while sample runs taken every few minutes by recording instruments, serve as a check and furnish the material upon which to base the motor's performance during the test.

A sample set of curves of such a test is shown in Fig. 2, indicating voltage, amperes and speed upon a time basis, all taken by recording instruments. The voltage indicated is that between third-rail and ground, but the motor voltage during running upon resistance may be taken as proportional to its full internal voltage at the

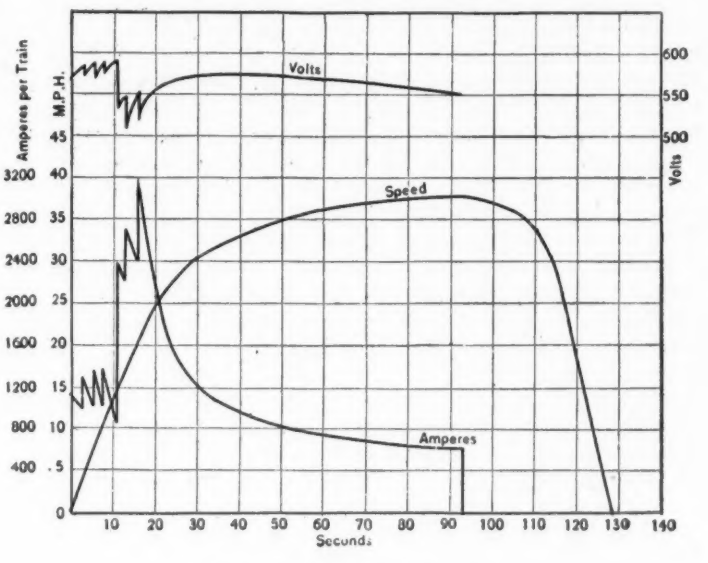


FIG. 2.—SAMPLE TEST CURVES.

moment of cutting out final starting resistance, without making any appreciable error in arriving at iron loss values. The ampere curves give the means of determining the copper losses by plotting on polar co-ordinates and determining the area by a planimeter giving directly the square root of mean square value.

By using recording instruments and by taking a sufficiently large number of curves, it is possible to determine very accurately the average losses dissipated as heat by the motor during the test run, and also ascertain the distribution of these losses in the several parts of the motor. The motor ventilation is the same as in a service run;

it is operated at varying speeds, remains at rest the required proportion of the total cycle ,and in every way the average conditions pertaining to a service run are reproduced in the test run, thus making the data so obtained directly applicable to service problems without the use of any constant.

A curve showing the results of a number of such tests is given in Fig. 3, indicating the degrees rise per watt loss in field copper and in armature with any relation between total armature and field loss. Here also, the total iron loss is assumed to be in the armature, and this loss, added to that of the armature copper, gives its total loss, used in determining the "ratio of losses."

Mr. Armstrong then proceeds to apply data as above obtained to the study of 25, 35 and 45-ton cars. A study of the resulting curves indicates that so far as motor heating is concerned, it is preferable to use the largest gear ratio and highest rate of acceleration possible for the accomplishment of the service contemplated, provided the maximum speeds are low, but that practically any rational rate of acceleration can be used where speeds approach a maximum of 60 miler per hour. As will be shown later, the energy consumption is less for a higher rate of acceleration permitting more coasting, but unforunately the fluctuations on the distribution system and the load curve on the generating station may both be much poorer if the accelerating rate is carried too high and the number of units in service is small. In the choice of gear ratio for a given service, therefore, not only must account be taken of the question of motor heating with different rates of acceleration, but due heed must be

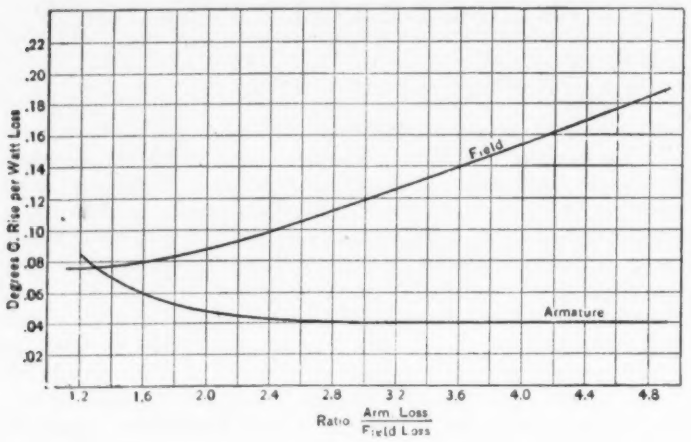


FIG. 3.—CURVE OF TESTS.

paid to the question of line fluctuations, station load and energy input. It may be possible that what is gained in car energy by a more rapid acceleration, may be lost by the poorer coal economy resulting from a more irregular load curve upon the generating station.

Curves are then given for the case of a specific motor for any schedule, any gear ratio and any frequency of stops. These curves show that the motor operates between the limits of one stop in two miles and four stops per mile, making a schedule of from 40 miles per hour down to 14 miles per hour, with approximately five tons per motor in all cases, and the same temperature rise. In other words, an equipment of this character is protected from overheating by properly proportioning its gear ratio to the car weight. The possible schedule speed for a given gear ratio is controlled by the number of stops per mile, but the heating of the equipment, with the proper weight of car, will be the same over a very wide range of schedules and stops. The curves, also, bring out very forcibly the importance of properly gearing an equipment for the work which it has to do. For instance, a gearing giving 60 miles per hour on a level track can make but 20.5 miles per hour schedule with two stops per mile with a train weight of 5.6 tons per motor, while the same equipment geared for 47.5 miles per hour can perform 20 miles per hour schedule (practically the same), but can do so with a total train weight of 12.8 tons per motor, or more than double the train weight possible for the same temperature rise with the 60 miles per hour equipment. In other words, the equipment should be geared for the lowest possible maximum speed that will permit the maintenance of the schedule in question, as a gear ratio givng too high a maximum speed for the work to be done not only overheats the motors, but produces needless demands upon the generating and distribution systems.

The motor in question at 60 miles per hour, when operating a single car has a capacity of but 5.3 tons per motor for 60 degrees rise, while if two cars are coupled together and operated as a single train, the reduction in wind friction per ton of train weight increases the capacity per motor of 7.5 tons for the same 60 degrees temperature rise, an increase of 42 per cent. This opens up a new field of inquiry as to whether it is commercially advisable to run single car units at this high speed when the motive power, and as it will be shown later on, the energy input, are both larger than would result from operating the same seating capacity in trains of two cars or more, with a correspondingly increased time interval between trains. In other words, is the electric traction idea of small units at frequent intervals a proper method of attacking the very high speed electric traction problem, or are we compelled to go back to the steam method of operating heavier trains at more infrequent intervals, in order to prevent a prohibitive investment in motors, and generating and distributing systems, and a ruinous expense for operation? It is true that the electric system, being eminently adapted to subdivision, has created the demand for travel, by means of its frequent service, where none previously existed, but it may be possible that for very high speed work too great a price may be paid for the privilege of operating very frequent small units.

The present method of rating railway motors is to determine the current which they will carry at 500 volts on a stand test, giving a temperature rise of 75° C. in the hottest part after 60 minutes' run. In other words, the one-hour rating of railway motors gives only an indication of the comparative capacity of two motors in actual service, and affords no data to serve as the basis of calculating the service capacity of the motor. It does determine the mechanical qualities of the motor, as the one-hour test is generally very severe, and it also affords a means of observing commutation at the maximum current for which the motor will probably be called upon in service operation. Mr. Armstrong considers that some method of rating railway motors which would give an accurate comparison of their service capacity under different conditions, if such a rating is possible, would be of great advantage over the present very general one-hour rating. He has not, however, arrived at any commercial rating of a railway motor which serves its purpose better than the one-hour test now universally used. Admitting that such a test does not give the comparative size of different motors, it does serve the purpose of largely determining its commutating qualities and possesses the advantage of being commercial. Unless a rating can be proposed which will indicate accurately the relative size of motors, the present method of one-hour rating possesses advantages which would hardly warrant its being superseded.

The paper next proceeds to a discussion of train energy, which subject is shown to be intimately interlined with the question of train friction and coasting. From curves figures are secured as to the cost of operation of a single car, and also trains of two or more cars, where the maximum speed is 60 miles per hour, and the stops very infrequent; that is the more advanced type of our private right-of-way suburban road. A single 35-ton car, having a friction, say, of 50 lbs. per ton at 60 miles per hour, will consume 119 watt-hours per ton mile at a schedule of 52 miles per hour with one stop in eight miles. Let two such cars be coupled together in a train, reducing the friction to 33.5 lbs. per ton, and the train will require an input of only 78 watt-hours per ton mile, or 65.5 per cent. of the energy rate per ton required in single car operation. In other words, single cars on 30-minute headway would require 52.5 per cent. more energy for their operation than would two-car trains on one-hour headway. With five-car trains, composed of 35-ton cars, the energy is reduced to 56 watt-hours per ton mile for the same schedule, or less than half what will be required per ton for the operation of single car trains.

From a purely energy standpoint it would seem that the operation of single-car trains was disadvantageous, but experience has shown that it is not fair to assume that two cars operated every hour will attract the same custom as one car operated every 30 minutes. In other words, the frequency of service creates travel, and in many cases warrants the extra expenditure for coal. There is another aspect of the case to be considered, and that is that with two-car trains at more infrequent intervals, the load upon the feeding points is more fluctuating, the size of rotary converters must be somewhat increased, and in all probability a larger amount of feeder copper will be required to keep the drop within the same limits. Although a saving may be effected in the coal pile by increasing the train

headway and giving the same seating capacity in trains of two or more cars, there is every reason to expect a call for a greater expenditure of money to install the road, and an increase in interest and maintenance account that may go far toward eating up the saving in the fuel expense.

In conclusion, Mr. Armstrong states that while it is possible to prepare a set of energy curves which are of fairly general application to all problems, it is only feasible to express the relation between motors of different capacity by a series of the special curves with which the paper largely deals. It is entirely possible to approximate the probable heating of motors of different sizes when the resistance, core loss and general construction is known, but such short-cut methods are at best only approximations and no true comparison of different motors can be made which will take into account their different losses for the same work performed and their capacity for radiating these losses at different speeds, without considering the subject in detail for each motor alone along the general lines indicated in the paper.

In dealing with the railway motor where the temperatures approximate 60° C. rise in practice, with an air temperature in summer reaching 30° to 35° C., there is not much leeway below a temperature injurious to the insulation, and approximate methods giving rise to errors of 10° or 20° C. in temperature cannot be seriously considered in such important calculations as the determination of railway motor temperatures. For this reason the methods outlined, although entailing a large amount of experimental work and subsequent calculations, are believed to provide an accurate method of determining the temperature of railway motors operating under any known conditions; and although they fail to provide a method of rating railway motors, it is due to the fact that such a method of rating cannot be expressed by any short term, but necessitates some such general curves as are also indicated in the paper.

RAILWAY SPEED-TIME CURVES.

Mr. C. O. Mailloux read from manuscript a paper with the above title, which dealt in an extremely complete manner with graphical treatment of street railway problems involving time and speed. The underlying principles were established analytically, and the method of their graphical application pointed out. It was shown that by such a system of treatment it becomes a comparatively simple matter to attack even complex cases arising in electric traction engineering.

The paper referred to the speed-time curve as the key to the solution of the general problem of determining or predetermining graphically the movement of a train at different intervals of time. Mention was made to the early use of speed-time curves, including their use by the author and Mr. S. T. Dodd, in 1898, and it was pointed out that the improvement in electrical engineering methods has given the speed-time curve additional interest and importance. It was shown that these curves may be used either as an approximative method, or as a method of precision. In the former method, the plotting of the curve is simplified by making certain assumptions; in the latter, such assumptions are to be avoided as much as possible.

The object of the paper is stated to be to facilitate the use of the speed-time curves as a method of precision, by simplifying their use. The paper then gives the technical definitions of the various kinds of terms. This is followed by a reference to analytical definitions, which are not contained in the body of the paper, but which are given separately in appendix portions—A, B, C and D.

Appendix A relates to time function curves of rectilinear motion. It begins with the fundamental definition of motion and develops the subject until an analytical definition is reached for time-rate of velocity, which is time-rate of acceleration.

In Appendix B the subject is further developed by starting from the fundamental equations of energy, until an expression is obtained for acceleration in engineering terms, in which speeds are measured in miles per hour, and velocity in seconds—time-rates of velocity being, therefore, equal to miles per hour per second. The subject is then further developed until it is shown that any force concerned in the movement of a train may be expressed in terms of an equivalent acceleration, and the important though simple theorem is developed showing that the effective acceleration in any concrete case is equal to the algebraical sum of the accelerations which will be produced by each of the forces acting independently and alone, and is consequently equal to the algebraical sum of the differential coefficients due to said forces. The first subdivision of the subject in the body of the paper is on the analysis of train motion. This subject is analyzed briefly, reference being made to the analytical treatmen in Appendix A and Appendix B. General analysis of this subject is followed by the specific analysis of the different forms of variable motion, including positive acceleration, and the two forms of negative acceleration, corresponding to the motion of trains while drifting and braking.

The second subdivision of the subject is on the plotting of speed-time curves. This subject begins with certain preliminary considerations, and then discusses separately the plotting of acceleration curves, drifting curves and braking curves. In this portion of the paper the author, after briefly referring to two other methods of plotting these curves, describes a new simple graphical method of plotting speed-time curves of all kinds, based upon the theorem developed in Appendix B, and also upon a formula for the time values corresponding to speed values as developed in Appendix C.

The method requires the use of two charts, designated in the paper as the chart of coefficients and the chart of reciprocals. The chart of coefficients contains various curves or lines, each giving as a function of the speed, the "equivalent" acceleration due or corresponding to each of the components of the effective acceleration. Thus, for instance, there is a curve giving what is termed the gross acceleration of the motor, or the acceleration which would be obtained if the tractive force of the motor were the only one concerned in acceleration. In like manner, there is a curve giving the equivalent acceleration corresponding to train resistance at various speeds. There are also various curves which correspond to the equivalent acceleration of grades, these being straight lines parallel to the axis of X, the distance above and below the axis of X being proportional to the percentage of positive or negative grade according to the case. In like manner, a curve of braking coefficients is drawn, giving the negative acceleration corresponding to each speed. When the braking rate of retardation is assumed constant, this curve becomes a straight line like the coefficient curves corresponding to grades.

The number of coefficient curves depends upon the number of components into which the speed-time curve is to be analyzed, or from which it is to be built up, in any particular case. A coefficient curve is required for each component. By means of these curves, plotted on the chart of coefficients, it is easy to obtain the algebraic sum of the various components, this being done by taking the difference between the sum of all coefficients which are positive, and the sum of all coefficients which are negative, all measured on the ordinate line corresponding to each particular speed. The resultant value, equal to the distance aforesaid, is then transferred to the chart of reciprocals, by means of which the time increment value corresponding to each speed is to be determined. On the chart of reciprocals, the ordinate values represent acceleration coefficients, just as in the chart of coefficients. The abscissae represent time values. The generic reciprocal curve is drawn, such that the product of the speed value by the acceleration coefficient is always equal to unity. Other curves are drawn in similar manner, which contain one-tenth, three-tenths, five-tenths of the reciprocal value, and other curves may also be drawn giving twice, three times, five times, and ten times the reciprocal value. The particular reciprocal curve used for determining time increment values is determined by the number of steps required in plotting the curve. These steps are determined in terms of speed increment. Thus, if the curve is to be plotted at points corresponding to every speed difference of one mile per hour, the generic curve will be used. The point at which the ordinate of this curve equals the resultant coefficient will have for its abscissa the time increment which is to be used in plotting the curve. If the point is to be plotted for every speed increment equal of one-half mile per hour, the curve giving the half reciprocal values on the chart of reciprocals must be used. In like manner, if the curve is plotted for every tenth mile, the corresponding reciprocal curve must be used. The author points out in the paper that while the plotting points may, without sacrifice of accuracy, be made farther apart in vertical distance, when the rate of acceleration is great, that is to say, when the curve has a relatively steep incline, this vertical distance must be reduced when the value of the acceleration coefficient decreases. The paper concludes with a practical illustration of the use of this method in plotting a run curve corresponding to a run on which there are grades and curves.

ELECTRIC RAILWAY DISCUSSION.

Mr. W. B. Potter referred to the fact that in some cases of steam railroad passenger traffic, the live load was but 1½ per cent. of the dead weight. At an acceleration of 2 m. p. h. per second, he said

that both starting and stopping acceleration curves should be hollow.

The general discussion was opened by Mr. Frank J. Sprague, who said that the Institute was to be congratulated on having so able an analysis of a problem of immediate and pressing importance presented at its meeting. He was glad to note that the power requirements agreed very closely, considering the changed conditions, with the result of a similar investigation made under his direction some three years ago. Mr. Arnold had very wisely confined himself to the problem of train movements within the limits of New York City, instead of complicating his report and confusing his clients by speculations as to the possibilities of through electric service, the methods for accomplishing which were still, and for some time were likely to be, matters of discussion and probable disagreement among the ablest engineers. For the specified service, the use of continuous current motors, to be operated at a moderate pressure, was the only safe recommendation. Mr. Arnold's paper had made a special comparison of steam and electric operation in the matter of economy, with the result that no special advantage had been shown in favor of one or the other. Economy, however, was in this particular case the least important consideration, and he did not doubt that Mr. Arnold believed with himself that while this comparison was a necessary thing to be presented, there was no question, not only as to the practical possibility of electric operation, but of its wisdom and even imperative need on the score of comfort and safety; and furthermore, that the financial results would also entirely justify the change. On account of the special nature of the problem, if the railway company should defer the adoption of electricity until some great saving in car-mile operation was manifest, steam would continue to be the motive power of the tunnel. Safety, cleanliness and comfort, however, being assured, increased dividends would most assuredly result from increased traffic.

The problem was a two-fold one—the replacing of the steam locomotive on through trains and the operation of the suburban service. The requirements were to be met in different ways. At present both were train services—locomotive operated. The through service must remain such, but the suburban could be readily changed. No less than ten or a dozen types and sizes of locomotives were now in use, and at limited speeds. Train weights vary from a hundred and fifty to six or seven hundred tons. It would seem, therefore, that in so far as locomotive service was concerned, it could best be performed by units of, say, 30 to 35-tons weight, and of 700 to 800 hp., these units to be so equipped and controlled that one could be used for the lighter service and two operated as a single-unit for the heavier.

This condition made imperative what has already been well settled —electrical instead of hand operation of control equipments, and the grouping and simultaneous control of units; in short, the multiple-unit system of operation. For suburban service, individual equipment of cars and like control of any required number was now beyond question. Another thing should be borne in mind, and that was that electrical equipment not only would insure greater safety of operation by clearing the tunnel of smoke and condensed steam, but the adoption of electrical control would leave the engineer free to devote himself to the safe piloting of his train, untrammelled by the distractions of other duties. Mr. Sprague concluded by saying that, so far as the possibilities of the case were concerned, he would not hesitate—and he felt sure that he voiced the conviction and readiness of others in the room—to undertake the feat of putting the heaviest train from Mott Haven to the Grand Central Station under electric power on schedule time within six months. Of course, such demonstration would be a special one, for considering the many civil engineering and railway problems involved, from two to three years would be necessary to make a general change.

Mr. F. S. Pearson highly complimented the work of Mr. Arnold, and spoke of the especial value at the present moment of the profession of papers like those of Messrs Arnold, Mailloux and Armstrong. At the present time he considered the subjects of electric suburban and long-distance high-speed traction of more importance than that of electric freight traffic. He expected within not many years to see 10-hour electric trains to Chicago. The steam locomotive was limited by the boiler, whereas electric traction was feasible and safe at 125 to 150 miles per hour.

Mr. Oberlin Smith considered that high-speed electric traction demanded a better roadbed than those of present steam roads, and also better types of cars and of a kind that could not be got off the track at high speeds.

President Steinmetz referred to the rapid development of the past few years in the theoretical branch of electric traction. A few years ago an electric railway project demanded scarcely any thought from the mathematical side, but now calculations of great refinement are necessary. There must be considered variation of friction with speed, momentum of parts of motors, etc., and a great amount of experimental data had already accumulated. Formerly, speed alone was considered, then its second differential or acceleration, and now its third differential or variable acceleration, and maxima and minima enter into problems. If through such refinements an increase of acceleration of one mile per second follows, it will mean much to rapid transit.

Mr. H. Ward Leonard recalled that in an Institute paper, read almost 10 years ago, he had described a system for long-distance traction. There was now being constructed at Oerlikon, according to that system, an electric locomotive for a railway that will have stations 17 miles apart, supplying single-phase current at 15,000 volts. The current will be transformed by a motor generator on the locomotive to direct current and supplied to motors that will give 700-hp at the drawbar. The weight of the locomotive will be 44 tons, all on the drivers, and the efficiency is calculated at 75 per cent. The cost of the conductors will be only $1,200 per mile. For control there will be no idle resistances nor opening of heavy currents. Variable speed will be obtained by varying the voltage of the direct-current side of the motor generator. The system allows close control of acceleration, and the restoration of energy at stopping and on down grades at any and all speeds. The method permits of a very perfect system of multiple control, involving no appreciable loss of energy, and of the utmost simplicity. The shunt motor employed obviates the objections inherent to the series motor.

Mr. A. H. Armstrong considers that long-distance, high-speed traction is entirely feasible from the electrical standpoint, using alternating current. The problem is really a mechanical one, and involves considerations with respect to roadbed, wheel-base, wheels, etc. While employing alternating currents, it is a question as to the employment of rotaries and direct-current motors or alternating-current motors.

Mr. W. B. Potter expressed the opinion that whatever type of current is used in long-distance traction, it should be used in the motor. The single-phase motor is the ideal motor; polyphase apparatus can be used, but it seems hardly probable that the development will be in the direction of the Leonard system. The indications point toward the three-phase motor for long-distance work. The present track gauge is small for high-speed motor equipments; six feet would be better. The present wheel-base and diameter of wheel should also be increased.

Mr. Bion J. Arnold made an important announcement concerning a single-phase railway system he is installing on a 20-mile road in Michigan. Mr. Arnold prefaced his remarks by saying that during the past three years, as many of the members of the Institute know, he had advocated the use of the alternating current motor for certain classes of railway work somewhat earnestly, and had often been asked by friends why he believed so thoroughly in the alternating-current motor, and was questioned at times for particulars regarding a certain system which he has been working upon. Mr. Arnold said that long before he had any fixed ideas as to a system of his own, a study of the railway question from an engineering standpoint partially convinced him of the necessity of the ultimate abandonment of the direct-current motor for heavy and long distance service, owing to its low working voltage limitation and the resulting heavy investment in transmission lines thereby required, as well as the many translations between the power station and the car when any great distance is to be taken into account.

An active connection with the development and construction of electric railways in this country impressed him with the correctness of preconceived ideas to such an extent that they finally crystallized into a system of electric railway construction upon which he has been working for several years. The statement was then made that twenty miles of road have been constructed for this system, together with the necessary trucks and motor equipments. Before entering into a description of the system, Mr. Arnold said that, as he had previously stated before this Institute, he is particularly anxious that American engineers shall keep abreast with European engineers in the development of the alternating current electric railway, and while

some brother engineers may not agree as to the practicability of his ideas, there are others in the Institute who believe as thoroughly in the alternating current motor for railway work as he does; and whether the system about to be described proves the correct solution of the question or not, he expressed the firm belief that the alternating current motor will finally prevail for heavy railway work.

The principles underlying the system, which Mr. Arnold names the electro-pneumatic system, are as follows:

1. A single-phase or polyphase motor, mounted directly upon the car, designed for the average power required by the car, and running continuously at a constant speed and a constant load, and, therefore, at maximum efficiency.

2. Instead of stopping and starting this motor and dissipating the energy through resistances, as is customary with all other systems proposed, the speed of the car is controlled by retarding or accelerating the field or stator of the motor, by means of compressed air, in such a manner that a portion of the energy is saved which is ordinarily dissipated through resistances, and stored to assist in starting the car, helping over grades, for use in switching purposes, and for the operation of the brakes.

3. By this method of control an infinite number of speeds are secured from zero to the maximum speed of the car, which latter may or may not be at the synchronous speed of the motor; for with the air-controlling mechanism working compressing, the speeds below synchronism are maintained, and by reversing the direction of the air through the controller, speeds above synchronism may be attained for reasonable distances. This feature gives to the alternating-current motor the element absolutely essential for practical railway work, for it permits a car or train to ascend a grade at any speed with the motor working at its maximum efficiency, and imparting its full power to the car. When descending the grade the motor may utilize its full power drawn from the line in compressing air, or it may be used to compress air with the stored energy of the train, thereby acting as a brake.

4. By virtue of the air-storage feature each car becomes an independent unit and capable, in case of loss of current from the line, of running a reasonable distance without contact with the working conductor, and this without the aid of storage batteries. This feature will enable a car to work on a high-tension trolley wire or active conductor over private right of way, and allow the active conductor to be stopped where the private right of way ceases, and the car to proceed through a city or town on any tracks, whether electrically equipped or not, until it reaches the outskirts of the city or town, where it can take up the working conductor again on private right of way. This feature is also valuable in switching work, for each car being independent it can leave the main line track and operate over switches or sidings without complicating the yards with additional overhead or third rail conductors, thus necessitating through line conductors over main line tracks or tracks only.

5. Since a single-phase motor can be used, the motors can be supplied with current from a single overhead wire or third rail, and with a single-rail return circuit, thus permitting the overhead constructions or third-rail construction to conform to the standard of to-day, except that a much higher working voltage can be used, provided the insulation is taken care of. Furthermore, in steam railway work this system, by virtue of its single-phase feature, will only require the use of one of the track rails for the return circuit, thus leaving the other rail for the use of the signal system, which, up to the present time, does not seem to have been satisfactorily solved without the use of one of the track rails.

6. The current will be taken from the working conductor at any voltage up to the limit of the insulation, and in case this voltage is high (the line is being built for 15,000 volts), a static transformer will be carried upon each car and the pressure reduced from the line voltage to the voltage of the motor, which in the case under construction is designed for 200 volts. Where it is unnecessary to utilize so high a line pressure, the motor may be designed for the working voltage and the current fed directly from the working conductor into the motor, thus eliminating the static transformer. When a high-voltage working conductor and static transformer are used, and it is thought advisable to use a working conductor through cities or towns this working conductor will be supplied with energy through a stationary transformer at each city limit, thus making the working conductor through the cities or towns safe.

7. By virtue of the speed of the motor and its constant load, either when the car is in motion or when it is standing still, and the motor is compressing air, the variable load now customary in electric railway power plants is eliminated, and the power station works at practically a constant load, thereby eliminating a large part of the investment at present requisite in power station and line construction. Furthermore, by virtue of the air storage feature, each car, in the particular apparatus designed, is capable at any time when current is on the working conductor, of delivering to the car wheels a much greater torque in proportion to the capacity of the motor than is possible with any electrical system known to-day.

In conclusion Mr. Arnold said he believed that by the adoption of this system the following results will be accomplished:

1. The entire elimination of the present standard system of rotary converter substation plant, together with the maintenance thereon and the cost of the necessary attendants.

2. It would absorb and render available for useful work in starting, or otherwise, a large percentage of the energy stored in the moving mass which under the present methods of operation is dissipated at the brake shoes.

3. A large reduction in the first cost of electrically equipping long distance railroads, thereby making it feasible, from an engineering and business standpoint, to equip many roads which cannot now be shown to be advisable, thus opening up the steam railway field to the industry in which we are now engaged.

FRIDAY'S SESSION.

At the session of Friday, six papers were read. One had been withdrawn from the programme of that day—the paper by Prof. Matthews on "A New Photometer for Incandescent Light and Insular Sources"—and the paper by Prof. Herdt carried over from Tuesday's programme substituted. The discussion of the papers took place after the last on the programme had been read.

The papers by Messrs. Thomas and Walker and Prof. Herdt appeared in abstract in our issue of last week. Mr. Thomas' paper gives an elaborate investigation of the principles of cylinder lightning arresters for high-tension lines, and with particular reference to the suppression of the arc which tends to follow a simultaneous charge to ground from the two legs of a circuit. A new type of arrester for this purpose was described which involves the use of series and shunt resistances in connection with the multi-gap arrester. A resistance is in series with the arrester, and a portion of the gaps are shunted by a resistance. In case a current from the generator follows a lightning discharge, the shunt will divert part of this current from the shunted gaps and the arc will then not hold in the latter; the combined effect of the shunt and series resistance will then so decrease the current that the unshunted gaps will be able to suppress it. The paper by Mr. Walker described the application of the Kelvin quadrant electrometer to the measurement of alternating-current energy, and particularly for testing purposes. Prof Herdt in his paper described indirect methods for determining alternator characteristics, and showed the dependence of synchronous reactance on the field excitation.

The paper by Mr. Thomas led to a discussion of considerable length. Dr. Perrine expressed the belief that it is impossible to protect long-distance transmission lines with any number of gaps, and that while the work which Mr. Thomas has done was of value, there is yet need for much more. One point not covered in the paper was the change in frequency when lightning occurs. The directions laid down by Mr. Thomas may apply to the power house, but they do not apply to installations on the end of a long line or in connection with heavy cable. He referred to a recent case where resonance occurred in a substation cable, the result of which was a short-circuiting of the cable and the destruction of a switchboard. The arc produces a high frequency, which may cause resonance, and as a consequence a cable may become distortionless and a large current flow. Such a condition cannot be overcome with any ordinary values of non-inductive resistance. Dr. Perrine suggested the use of selective resistances to meet the case of resonant frequencies. No satisfactory solution will be arrived at until investigations are practically applied

to cables and long-distance transmission lines. Prof. Elihu Thomson agreed with Dr. Perrine that laboratory experiments are not sufficient, it being necessary to experiment with actual lines. Mr. Steinmetz discussed at some length the theory of lightning arresters. The three principal requirements are series resistance, many spark-gaps and a large sparking surface. The ideal case would be where no resistance was offered to the discharge, but short-circuited arcs are dangerous on account of the surgings to which they give rise, and, therefore, enough resistance should be used to damp out oscillations. The lightning arrester should, therefore, discharge without holding an arc, and consequently the voltage to maintain the arc should be less than the sparking voltage. Curves were given, showing the relation between the voltage to sustain an arc and the voltage necessary for sparking. By plotting such curves it will be found that they cross and the gap distance should correspond to an ordinate less than that of the common point. Curves were also given showing the variation of the arc distance with the current and with the temperature. In the design of lightning arresters the amount of current apt to follow an arc, the temperature at the sparking surface, and the proper relation of the e. m. f. to cause sparking and that to maintain sparking are all factors. Not only does the amount of surface of the sparking cylinder enter, but also the character of the material. Prof. Thomson referred to some investigations made by him some years ago, in which he used condensers for shunting spark-gaps. By employing condensers the series of gaps would break down more easily. Mr. Percy H. Thomas said that the resistance in the lightning arrester tended to overcome resonance. Instead of shunting a number of gaps the shunts might be across pairs.

ENERGY LOSS IN COMMERCIAL INSULATING MATERIALS WHEN SUBJECTED TO HIGH POTENTIAL STRESS.

In a paper with the above title, Mr. Charles E. Skinner gives a very complete account of tests made on various insulating materials used in commercial manufacture and also on the insulation of finished apparatus. For these tests, alternating current at frequencies of 25, 60 and 133 cycles was used, the e. m. f. varying from a few thousand volts to 100,000 volts. The results have a direct bearing with respect to the dielectric strength of finished apparatus at very high voltages. The tests were usually made by placing the material between metal plates, which were connected to the terminals of a high potential transformer. To measure the temperature usually a small coil of very fine copper wire was placed in the material, and the temperature determined by its increase of resistance. The most satisfactory temperature readings, however, were obtained by placing at the point where the temperature was to be measured a copper-lead couple connected to a sensitive galvanometer. The following are the results given of a series of tests on the variation of temperature due to variation of stress:

1. With moderate stress the temperature of the material rises rapidly at first, then more slowly, then becomes constant. The actual rise in the temperature for a given voltage depends on the facility with which the material can dissipate its heat and on the temperature of the surrounding medium.

2. As the stress is increased a point is finally reached where the heat is developed at a greater rate than it can be carried away, and temperature then rises until the material chars and break-down results.

3. When material is not thoroughly dried, the temperature rises much more rapidly than in well-dried stock. The increased temperature cannot be accounted for by the increased $C^2 R$ loss due to lower insulation resistance. The heat generated tends to dry out the material and the temperature may fall as the drying proceeds.

4. With a considerable area of material under test, the temperature of small portions frequently rises above that of the surrounding material to such an extent that on examination these portions are found much discolored, while the surrounding portions remain unchanged. This effect is especially noticeable with treated material not perfectly cured. The final break-down in such cases is invariably found in one of heated areas.

5. The final break-down in fibrous materials usually results from the burning of the material and not from mechanical rupture. When the e. m. f. applied is far above the dielectric strength of the material, the break-down may be due to a mechanical rupture. If, however, the e. m. f. is sufficiently low, so that an appreciable time elapses before break-down occurs, the break-down is probably due to burning, caused by the heat generated in the material. There may be some attendant chemical action, but this is thought to be a result and not a cause of the excessive heat. The lower the e. m. f. applied, the longer the time required to produce break-down under a given set of conditions.

6. It follows from (5) that if the temperature is kept low, either by providing good ventilation or by artificial cooling, the stress required to cause break-down in a time test will be much greater than if the material is not so cooled.

7. The actual temperature measured in most fibrous materials before break-down occurred was usually 175° C. or more. In no case did a break-down occur directly at the point where temperature measurements were being made, and the temperature at the breaking down point was probably higher than measured, especially as the rise in temperature seems to be very rapid at the point of break-down just before this occurs.

8. With a given stress, the initial and surrounding temperature has much to do with the rise. This is due to the fact that the loss in the material increases rapidly with temperature. For example, if the material and surrounding air are at 20° C., and the stress applied is 20,000 volts, the rise in temperature will not be nearly so great as if the initial and surrounding temperature is at 80° C. Tests have shown that break-down frequently results under the latter conditions from a stress that would not injure the material under the former.

The paper gives a number of characteristic curves of rise in temperature of insulating materials when subjected to high potential stress. The variation of loss due to variation of temperature was investigated, measurements being made by means of a calorimeter in some cases, and in others by a special static wattmeter. The following are the conclusions from this series of tests:

1. The energy loss in fibrous material increases with temperature, the rate of increase in the loss being greater than the rate of increase in the temperature.

2. The rate of increase depends upon the kind of material and on its condition with respect to dryness, etc.

3. The local heating found in a mass of poorly ventilated material is due to a greater initial loss in one portion, causing increased heating, this in turn causing greater loss, etc., until the temperature finally reaches a point at which charring and break-down result.

4. The curves plotted from the tests show that the rate of increase of loss is greater at high than at low temperatures, therefore giving the reason for the greater rise in temperature with a given stress when the initial temperature is high than when it is low.

5. The loss increases very rapidly, indeed, when temperature approaches the charring temperature of the material.

6. Losses as great as 5 watts per cubic inch have been measured in material before serious injury resulted, due to charring. A considerably less loss than this will, however, char the material unless special means are taken to dissipate the heat generated.

7. It follows from considerations of rise of temperature due to increased stress, and increase in loss due to increase in temperature, that a long-continued test at high stress may seriously injure the insulation of a piece of apparatus without this being made apparent by the test. This has often been spoken of as "straining the insulation" for want of a better term, the idea being that this was in some way analogous to the straining of a piece of metal beyond its elastic limit. It is probable that this "straining" is always due to charring.

Still another series of tests were undertaken to determine the variation of loss of voltage, the voltage remaining constant. The tests showed a fair agreement with the Steinmetz law, the increase in loss usually being slightly greater than the square of the e. m. f. With respect to the variation of loss with voltage, the temperature varying, due to the loss itself, there is, as stated above, a rapid increase in the energy loss in a body of insulating material, due to increase of temperature; also that the energy loss varies approximately as the square of the voltage when the temperature remains constant.

1. It follows, therefore, that under the usual conditions of high potential stress the loss will increase more rapidly than the square of the voltage, because the temperature increases at the same time.

2. The rate of this increase will depend on the facility with which the material can get rid of its heat, and on the length of time the material is subjected to each successive stress in carrying out the test.

3. It will also depend on the initial temperature of the material and the temperature of the surrounding medium.

It will be seen that many of the conditions named under variations of temperature, due to variation of stress, apply to this case.

The variation of loss due to variation of frequency was also deter-

mined, and the results plotted as curves. The curves show that the rate of variation is approximately in proportion to the frequency at the lower temperature, but follows a different law at the higher temperatures. In some tests which were carefully made, the loss varied approximately as the square root of the frequency, but Mr. Skinner does not consider that these results are sufficiently well substantiated to be announced as a law.

The final section of the paper deals with energy loss in the insulation of large alternators. The measurements were made to determine the energy loss in the armature insulation of the 5,000-kw Westinghouse alternators, built for the Manhattan Railway Company. These alternators are star-connected, three-phase, 11,000-volt machines. Loss measurements were made at approximately 5,000, 10,000, 15,000, 20,000 and 25,000 volts. The amount of insulated material under stress in these tests was approximately 19,500 cu. ins., giving a maximum measured loss of .35 watt per cubic inch at 25,000 volts. At a stress of 11,000 volts between the windings and the frame, the loss measured was less than 1 kw total for the machine; the total loss, however, at 11,000 volts is less than ½ kw under normal conditions.

The curves plotted from these tests show that the variation in loss due to variation of stress is slightly greater than the square of the stress applied, which increase cannot be due to temperature, as the total loss is not sufficient to cause appreciable heating. The increased loss at the higher temperature is somewhat greater than was to be expected from measurements made upon the small samples of material. The loss at 25,000 volts is not sufficient to cause any injurious heating even in a long continued stress. The rate of increase of loss indicates that at a point not far above 25,000 volts the loss will be sufficient to cause heating and possibly damage to the insulation if the stress were applied for any considerable length of time.

Mr. Skinner concludes that it is not possible to state in general terms the safe limiting stress which can be applied in a time test to a piece of high potential apparatus, but measurements of the loss and a knowledge of the materials used will give the designer some idea for any particular machine. Such tests are very rarely necessary, and should not be required on ordinary commercial apparatus. When a time test is required, it should be at a voltage much below the dielectric strength of the insulation under test.

In the discussion of Mr. Skinner's paper, Prof. Nichols pointed out that the breaking down of an insulation must sometimes be ascribed to local heating rather than to dielectric stress. Mr. W. S. Andrews said that mica is more easily punctured if oil is present, and Mr. Skinner added that a slight film of oil on mica will largely reduce its dielectric strength. Prof. Perrine pointed out the similarity of the curves in Mr. Skinner's paper with those of long cables for high potential, and insulated with gutta-percha. Cable work has shown that the presence of slight moisture will increase the heating and result in a breakdown. In testing, it is often found that the heating largely exceeds that due to C^2R, and this excess comes from the presence of moisture. Where there is moisture there is electrolytic conduction, and it is found that a disconnected cable as a consequence may act as a storage battery. In one case a certain cable could not be used in testing for this reason. Some experiments made by Mr. Newbury, of Roeblings, indicate that when the diameter of a cable is increased above a certain point, any further increase does not increase the disruptive strength. Dr. Perrine also ascribed the lowering of disruptive strength to conductive vacuous spaces, and an examination in some cases when rubber cables had broken down under less than the proper e. m. f., had disclosed such vacuous spaces. Prof. Elihu Thomson agreed with Dr. Perrine as to the non-effectiveness of insulation beyond a certain thickness, and offered the explanation that the stress being a radial one, increases in diameter beyond a certain point, does not change the intensity of the stress; the remedy is, therefore, to increase the diameter of the metallic portion.

Referring to an oil film on a mica plate, Prof. Thomson expressed the opinion that the effect of oil was to concentrate the stress at the thin portions of the film. Mr. C. O. Mailloux referred to some experiments which showed that glass between two e. m. fs. may increase the intensity of the stress over that of dry air. In certain cases of insulating materials that become softened at a certain temperature, in every case the area about the puncture became thin before the puncture occurred. In this case there are three actions leading to disruption, namely, dielectric stress, increase of temperature and thinning. Mr. Percy H. Thomas called attention to the fact that the results given in Mr. Skinner's paper are the result of many years of practical work dealing with commercial materials. While not directly applicable to cable work, yet they apply to materials for cable insulation.

Mr. Wm. Maver said that in the manufacture of cables, if the insulation is very thick the moisture is not expelled by the usual application of heat, and there is not proper penetration of the compound when plunged in the same. The remaining moisture not only reduces the dielectric strength of the cable, but the resulting heat also leads to deterioration. Prof. Woodworth, of Lewis Institute, Chicago, gave the result of some experiments as to the effect of moisture in transformer oil. The presence of .9 per cent. of moisture caused the insulation strength to drop in the ratio of 16 to 2, at the latter point being less than that of air. Mr. Steinmetz corroborated the statement, and added that after a transformer has been in operation some time the insulation increases, which is to be ascribed to the drying out of the moisture by the heat. Referring to the remark of Mr. Mailloux concerning thinning out under dielectric stress, Mr. Skinner said that he had noticed pitting and grooves in glass subjected in oil to dielectric stress, and that there was undoubtedly a mechanical action. He also confirmed Mr. Steinmetz's statement that heating oil increases its dielectric strength. Mr. Steinmetz said that in some experiments with paraffine he found that with frequencies from 1 to 250 the energy loss varied as the square of the voltage, and the power factor was independent of the frequency, but that the second power variation only held up to the dielectric elastic limit. A great source of loss in dielectrics is occluded air.

A NEW WAVE TRACING INSTRUMENT.

Professor R. B. Ownes, gave an account of a new method for conveniently and accurately tracing current curves in circuits of small resistance and inductance without appreciably altering their time constants. As will be noted from the illustration, Fig. 1, in general appearance the instrument is similar to the ordinary differential galvanometer with the exception that the usual suspended permanent magnet with attached mirror is replaced by a circular coil of fine wire supported by two thin phosphor-bronze suspensions.

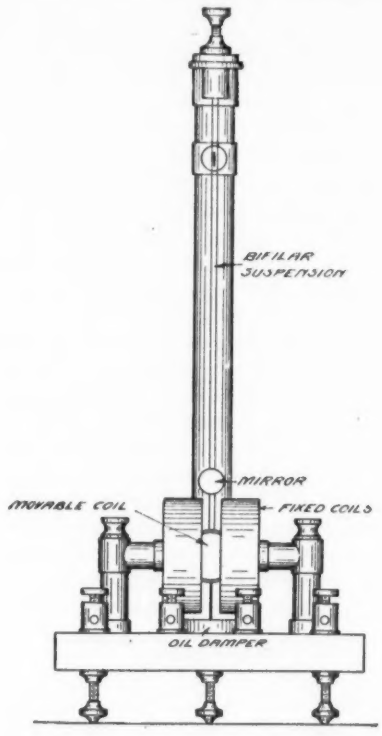


FIG. 1.—WAVE TRACING INSTRUMENT.

The action of the instrument is as follows: The variable current of which a trace is desired is introduced into, say, the outer pair of the two concentric coils, a suitable direct current is sent into the inner pair of coils and a contact maker sends an impulse of current from a constant source of e.m.f. through the movable coil. If the the D. C. current in the inner fixed coil is equal and opposite in magnetic effect to the instantaneous value of the variable current at time of contact, no deflection of the movable coil will be observed.

If a deflection, however, does occur, the D. C. current is carried until such deffection becomes zero, then the D. C. current, as read by an ordinary Weston ammeter, equals to within a constant the instantaneous value of the variable current for the particular setting of the contact maker used. The constant of the instrument is readily obtained by measuring the ratio of the currents in the two fixed coils required to produce no deflection of the movable coil when a small current from a separate source is sent through it.

Shifting the contact maker arm, as many points may be obtained as are desired. The instrument is extremely sensitive, allowing perfectly satisfactory traces of currents a fraction of a milliampere effective value to be obtained, and its range can be varied to almost any extent by the addition of fixed coils. When measuring very small currents it must, however, be shielded or corrected for stray fields.

Some of the applications to which the method has been put are as follows: The tracing of alternate current e.m.f., and waves; obtaining curves of growth and decay of currents in inductive circuits, when constant e.m.fs. are applied; obtaining curves of rate of growth and decay of such currents; obtaining leakage coefficients of large generators, the time constants of whose fields make the use of ballistic or of damped galvanometers for accurate work impracticable; the determination of the variation in a single revolution of the angular velocity of engine flywheels; the determination of the fluctuations in currents from commutating machines.

Fig. 2 gives the connections for obtaining an ordinary current wave from an alternating-current generator. A milliammeter is put in series

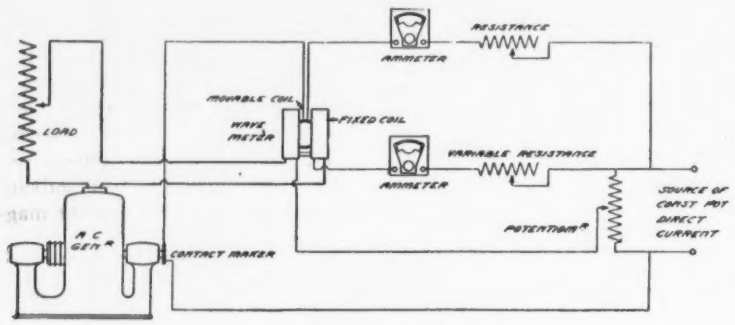


FIG. 2.—DIAGRAM OF CONNECTIONS.

with the movable coil of the instrument as a convenient means of knowing whether or not the contact maker is operating satisfactorily. The average curent ned not exceed four or five milliamperes. For obtaining the e.m.f. wave of an alternating current generator, a larger number of turns of fine wire are used in the outer fixed coils, together with a suitable non-inductive resistance in series with them, the whole being connected across the generator terminals.

The variation in a single revolution of the angular velocity of an engine flywheel may be measured as follows: A disc dynamo with fields constantly excited is directly driven from the engine shaft and the curent trace from it obtained as a function of angular displacement, such current at any instant being proportional to the angular velocity of the flywheel at the same time. It is necessary to use a disc dynamo or one having a great number of commutator segments, as otherwise the variations in the curent due to the angular displacement of adjacent armature coils will mark the variations due to a change in angular velocity. The value of the method described by Prof. Owens lies largely in the fact that it is a zero method.

STANDARDIZATION REPORT.

Dr. A. E. Kennelly presented the revised report of the committee on standardization, and explained the changes that had been made by the committee. The report differs from that of 1899 mainly in the addition of a number of paragraphs, though some changes appear in the older part. Prof. Owens criticized the method of computing the regulation of synchronous machines. Dr. Kennelly and President Steinmetz in reply said that the method is supported by practical experience, and that while the rule might not apply exactly in abnormal cases it covers all commercial machines; moreover, the general method given is much better than special methods, and it is not possible commercially to obtain the data by actual tests, owing to the size of machines and the circumstances under which they are manufactured and operated. Considerable discussion ensued on the rating of incandescent lamps. Mr. John W. Lieb, Jr., said that while mean horizontal candle-power is not scientific and does not take in flux of light, it is so rooted in the art that it would be unwise at present to make a change. At the beginning the incandescent lamp was handicapped through the adoption of the method employed in determining the candle-power of a gas jet, and to adopt now the spherical rating would act still further to handicap it with respect to gas. Prof. Matthews referred to a photometer, which he has recently devised, which gives a mean spherical candle-power at one setting. He defended the Heffner unit, and believes that ultimately we will have to come to a complete system of photometric units. Prof. Nichols supported the method of Institute rating, and congratulated the committee for putting emphasis on the total flux and for defining the Heffner unit. Mr. Hering said that the National Bureau of Standard favors the Heffner constant adopted—.88—and Mr. Lieb added that the Reischanstaldt employs that ratio. Prof. Nichols said that owing to the great variation in candles, the ratio of the Heffner unit to the candle-power unit could not be experimentally determined, and, therefore, must be assumed at an average value, and he considered that .88 is the best value to fix upon. Mr. Lieb suggested that the Institute adopt rules for making electrical measurements and determining the commercial accuracy of instruments, which suggestion was supported by Mr. Calvin W. Rice, it being held that an expression of opinion on the part of the Institute as to determining the commercial accuracy of wattmeters especially was very valuable. Elsewhere in this issue the revised report of the committee on standardization is referred to editorially.

DETERMINATION OF ALTERNATOR CHARACTERISTICS.

In the absence of the author, Prof. R. B. Owens read the paper of Prof. L. A. Herdt on the indirect determination of alternator characteristics. Prof. Owens laid stress on that part of the paper which deals with the influence of field excitation and armature reaction on the determination of the regulation. If the determination factor of synchronous reactance does not consider field excitation, the result will be incorrect if, as in the case of the short-circuiting method, the field excitation is much below normal.

President Steinmetz complimented very highly Prof. Herdt's paper, which he pronounced a valuable contribution to the subject of determining the synchronous reactance from an actual machine; moreover, he admired the method of the paper, which was not only engineering in character but also strictly scientific. While the paper does well in bringing out the discrepency that may exist between the calculated and the actual synchronous reactance in abnormal cases, in point of fact the commercial machinery the difference disappears in the testing room. Prof. Goldborough pointed out that in a paper read by him at the Elliott, Maine, Institute meeting, in 1896, he showed the effect of variations due to loading and the variations due to the relative positions of a coil and the pole. Prof. Owens considered that the paper showed conclusively that a large error is apt to arise if the synchronous reactance is calculated by the method given by the report of the Institute's Standardization Committee. While the accuracy was quite good with high excitations, this was not true with low excitations. In commercial testing, Dr. Perrine considered that the characteristics could be predetermined without considering the degree of excitation. In reply to a question, Prof. Owen said that the Herdt m. m. f. method applied both to the inductor and to the revolving field machine. Mr. C. H. Himes referred to the great difference that appears to exist in the rating of motors of the railway type. He finds that in the case of motors rated at 50-hp they may run up as high as 80-hp. This discrepency, he said, introduced complications in buying motors for a given work, particularly in the case of steel plants where inexpert operators may endeavor to get the same power out of motors having different actual capacities.

SATURDAY'S SESSION.

The session of Saturday was opened by President Steinmetz, who had chosen as his presidental address the subject of engineering education. We reprint below the address in full:

With to-day's meeting ends the first Institute year in the new century, and it may be appropriate then to look back into the work achieved and forward into the future.

At the entrance of the 19th century we see empirical science struggling for recognition against metaphysical speculation. At the entrance of the 20th century metaphysics has practically ceased to be considered and empirical science is universally acknowledged as the source of all human progress. In gradual advance from success to

success this victory has been won. Without any restraint empirical science can now expand. But with the removal of the opposition of an hostile philosophy, has been removed also the searching criticism into the correctness of the results, the methods and the theories propounded by empirical science, and thereby the absolute safety which characterized the work of the earlier period. Herein lies the greatest danger to the unbroken progress of science.

Facts, whether incidentally observed, or intentionally, by experiment, are the foundation of science. But the mass of facts has accumulated so as to be beyond comprehension, and we are forced thereby to work with the conclusions from the facts, the empirical rule, theory, hypothesis, and have become so used thereto that gradually the dividing line between the theory and the underlying facts has become blurred, and we consider the theory and attribute to it the same certainty as only the facts have on which it is based. But, however well a theory represents the facts and proves its value in successful application, it unavoidably contains besides the facts on which it is founded, foreign elements, mainly the personal equation of its originator and the personal equation of its times. And when building upon theories, the danger exists that instead of upon the facts represented by the theory, we may build upon the personal equation of the time without realizing the unsafe foundation of our structure.

The reverence for the facts as the foundation of science has been extended to the theories based thereon. But when by building theories upon theories, conclusions are derived which cease to be intelligible, it appears time to search into the foundations of the structure and to investigate how far facts really warrant the conclusions. If we are told of matter moving in a vacuum tube with velocity comparable with that of light, of small chips breaking off atoms, of free atoms of chlorine and sodium floating around in a salt solution charged with opposite electric charges, whatever that may be, of electricity being propagated not through the conductor, as we used to assume, but through the space surrounding it, etc., it is time to pause and try to understand.

In the gradual replacement of facts by the belief in theories, more or less inadequately representing the facts, lies the chief danger to further scientific progress. Here is a field where splendid work can be done and should be done, in destructive criticism, by the younger generation, which, after leaving college with all the theoretical armament required, is not yet handicapped by personal relations with the men whose names are identified with the ruling theories.

Especially for our branch of electrical engineering, this is of fundamental importance, since all the success of our work depends upon the absolute safety of the foundations on which we build.

All future progress in science and engineering depends upon the young generation, and to insure an unbroken advance it is of preeminent importance that the coming generation enters the field properly fitted out for the work.

Here the outlook appears to me by no means entirely encouraging.

It is not the object of the college or university to turn out full-fledged engineers who can handle any engineering problem of any magnitude. Heretofore the available time is altogether too short, and especially a very great deal of practical experience is required, which is not available to the educational institution. It is not necessary, either, and the college graduate is not expected to take immediate charge of engineering works of great magnitude. All the educational institution can do and should do is to fit the student so to take up the practical work as efficiently as possible, and that is to give him *a thorough understanding of the fundamental principles of electrical engineering and allied sciences,* and *a good knowledge of the methods* of dealing with engineering problems.

The average college course at present does not do this.

One of the reasons of the inefficiency of the present college course is the competition between colleges. By trying to teach more than other colleges, gradually the quantity of material taught by our colleges has increased so that it is not possible any more to give a thorough understanding, and memorizing takes the place of understanding. Memorizing, however, is an entirely useless waste of energy, since anything that is not perfectly understood, but merely memorized, will be forgotten in a short time if not continuously applied, and if continuously applied it would be remembered anyway. If of the amount of material in electrical engineering as well as other branches which the educational institution of to-day attempts to teach, one-half or more would be dropped altogether, but the rest taught so as to be fully understood, with special reference to general principles and methods, the product of the institution would be far superior and more successful in practical life. To be dropped, then, are all formulæ, rules, etc., beyond the most simple ones, of the scope of the multiplication table, etc. When needed, formulæ can be derived from the fundamental principles or looked up in the literature, and their memorizing is a mere waste of valuable time, unless since the memory cannot retain them if the understanding cannot reproduce them from their premises. This, for instance, applies to the various formulæ of electromagnetic induction, the equations of the transformer and other apparatus, and theoretical investigations in general.

Still more than in electrical engineering this applies to the allied branches of science and engineering, of which the electrical engineer should have a fair understanding. Here anything beyond fundamental principles is objectionable. The electrical engineer should understand the principle of the steam engine, of the hydraulic turbine, know why the spouting velocity and the peripheral speed of the water-wheel are related to each other theoretically, and how this relation is modified actually, but should not memorize the mathematical theory of the turbine with its half dozen unknown friction coefficients. He is not expected to design turbines, and if he did, his design would surely be a failure, but he is expected to understand the turbine, the steam engine, etc. The engineering graduate should know the principles of the strength of materials, the distribution of forces in the loaded beam, the reasons leading to the I-beam, to the triangle in bridge and roof construction, but time should not be wasted in calculating bridges or deducing elastic curves, etc.

In short, in electrical engineering, and more still in all allied branches, nothing beyond the general principles is needed for success, but the principles should be fully understood, and with the limited time at disposition this cannot be done if time is wasted in memorizing things to be forgotten afterwards.

One of the objectionable features of the instruction of most colleges is the step by step method. One subject is taken up, by application of sufficient time and energy pushed through, and then after passing an examination dropped to take up another subject. It is true that by steady application to one subject a great deal can be learned, and so splendid results derived in the examination papers, but all that is learned in this manner is forgotten just as rapidly. To understand a matter thoroughly, so as really to have a lasting benefit therefrom, and not only make a good showing in examination papers, requires several years familiarity therewith. Any subject, therefore, that is not kept up during the whole college course might just as well be dropped altogther and the time spent therein saved.

We hear that college graduates have no mastery of the language, cannot express themselves logically, and, therefore, recommend that more time should be devoted to literature and instruction in the English language. But as long as we do not teach logic, but have English language taught by philologists, more or less of the character of the florid newspaper style, that is to write very many words on a very small subject, no useful results can be expected. Logic should be taught by a scientist, and the principle of English teaching to engineers should be to enable them to explain a subject intelligently and logically, with as few words as possible. That is, Faraday's reasearches, and not the product of the successful novel writer should be the example aimed at.

The combination of text book and home work offers a splendid means for incompetent instructors to make an elegant showing in the examination papers and turn out a very inferior grade of men, men who sometimes do not even know what real understanding means. Free lectures on subjects which the instructor himself thoroughly understands (which is by no means always the case now) make it possible to direct the course so that the student's understanding follows the course, and in this case home work becomes superfluous, excepting in connection with the laboratory. Reviewing the lectures and filling out the gaps to absence, etc., appears to me the only legitimate requirement on the student's time outside of the lecture room.

The present method of examination, which consists in expecting the student to answer ten questions or so within a few hours, is faulty. It shows what the student has memorized, but not how far he understands it. Furthermore, the brilliant student who usually answers nine out of ten questions correctly, and would have answered the last if he had not made a slight mistake, displaced a decimal point or so, in practical life may be utterly useless, since while doing

very rapid work, his work is not reliable, while a slow man who, however, can absolutely rely on the correctness of his work, will be very successful in practice while hardly passing the college examination.

What, then, should an ideal electrical engineering course contain?

Of mathematical, plain and some solid geometry, arithmetic, and a good knowledge of algebra. Plain trigonometry—no spherical trigonometry required—and a thorough understanding of analytical geometry and of calculus, but no memorizing of integral formulæ, etc.; they can always be looked up in a book when needed.

A thorough knowledge of general physics, especially of the law of conservation of energy, which, I am sorry to say, is not yet an integral part of our thinking, and of chemistry, especially theoretical chemistry and chemical laboratory, in the latter freely using tables, etc.

The electrical laboratory work should be taken up right in the beginning. Even before taking up the theory of apparatus, the theoretical investigation of alternating currents, self-induction, transformers, etc., the student should have met this phenomena and handled the apparatus in the laboratory. Only after seeing the effects of self-induction, for instance, on the alternating-current circuit in the laboratory, the theory of self-induction will have any meaning and make an impression on the student. What the student has seen practically in the laboratory he will then take up in the theoretical course, to understand it, learn to calculate and control, and afterwards going back once more to the laboratory, apply it. It is here where the average college graduate is inferior to the practical man, and in spite of his handicap regarding theoretical knowledge, the latter frequently pushes ahead of the college graduate by his superior understanding of the phenomena, based on his familiarity with them.

Design of electrical apparatus is of very secondary utility, and rather objectionable, with the exception, perhaps, of some very simple apparatus. The considerations on which designs are based in the engineering departments of the manufacturing companies, and especially the very great extent to which judgment enters into the work of the designing engineer makes the successful teaching of designing impossible to the college. Far better is the reverse operation, the analytical investigation of existing apparatus, and more instructive to the student. That is to derive from existing first-class apparatus by measurement and test, the constants of the apparatus, and to calculate these constants and compare them with tests. Besides, a very small percentage of the college graduates enter the field of designing, but most of them will have to handle apparatus, and it is, therefore, very much more important to be familiar with the completed apparatus in all its characteristic features, in normal and in abnormal operation, than to be able to design it.

The preceding naturally can be a short outline only of the work which I consider appropriate to an electrical engineering course, but I believe the general principles of the course can herefrom be understood. They are to give the student all the ground work required to be successful in future practice, but not the impossible aim of giving him a complete education as practical engineer.

After Prest. Steinmetz's address five papers were read on the same subject, the authors being Profs. Samuel Sheldon, R. B. Owens, E. B. Raymond, Wm. Esty and Mr. Harold W. Buck.

Dr. Sheldon pointed out that the determination of a curriculum does not lie wholly in the hands of the officers of the educational institute but is influenced by the student body. The average student attends a technical school in order to get that which will enable him to earn a living, and wishes to be placed in a position to earn such a living as soon as possible. Dr. Sheldon considers that that a course in electrical engineering to meet the desires of its patrons, should be laid out with a view to securing the best possible positions for its graduates. The initial rapidity of the advancement of a graduate depends upon his technical education and could be made a maximum by a thorough understanding between the employer and the educator. His ultimate position, however, seems to be dependent almost entirely upon himself and very little directly upon any special feature in his educational training.

The paper discusses the difference between the electrical engineering courses in this country, and the conclusion is arrived at that the great difference which exists suggests prodigality in the expenditure of a student's time, and also suggests the possibility of obtaining much higher teaching efficiency by the adoption of curricula uniform not only as to the time to be devoted to the different subjects, but also to the topics to be treated in that time and as to the manner of their treatment. Dr. Sheldon considers that the present electrical engineering graduate lacks the broad mindedness associated with graduates from classical and art courses and which, as a whole, is considered as a condition of a liberal education. The average graduate from a liberal classical course possesses a breadth of culture which is easily distinguished as being in excess of that possessed by the average technical graduate. This difference, however, might be largely eradicated by a single carefully planned course of lectures.

Prof. Esty believes that safe rules to follow in laying out a course for electrical engineers are to teach thoroughly those things in college which are fundamental and to devote little time to highly specialized subjects; to introduce the student to those branches of knowledge which in his later life he can obtain only with increasing difficulty if at all; and to increase in him a hunger and thirst for deeper knowledge so that he will remain a student through life. As showing the great strength of the movement toward technical education, Prof. Esty points out that there are now more than 10,000 sudents enrolled in our technical schools, and that more than 50 institutes in this country give instruction in electrical engineering, the students pursuing this course alone numbering over 2500.

The ideal education of an engineer, Prof. Esty considers, would be in following a liberal and scientific course of a general nature, covering 3 or 4 years, succeeded by a special technical course extended over 2 or 3 additional years. Granting, however, that a preliminary liberal college education is a good, if not necessary, preparation for an electrical engineer of to-day, it is of the utmost immediate importance to determine how a technical course should be organized to produce the best possible results in the limited time of four years. The present practice of combining two radically different groups of students in a single four years' course, is pronounced fundamentally wrong. Prof. Esty considers the subject of text-books and points out the importance of the commercial aspect of electrical engineering, which should be recognized by familiarizing the student with trade literature, manufacturers' drawings, photographs and samples, visits of inspection to manufacturing establishments, the encouragement of students to engage in practical work during the summer vacation, and a course of lectures from men of affairs and from specialists in certain lines. The method of teaching in a laboratory is elaborated and the seminary method of instruction is commended. Prof. Esty views with favor the teaching of design not so much for its practical as for its educational value. He lays stress upon systematic laboratory work, but condemns both over-directed and under-directed supervision.

Mr. Harold W. Buck considers that while in the past some of the most successful electrical engineers have belonged distinctively to the class of practical men with little theoretical knowledge, the conditions have changed. The extraordinarily rapid growth of the electrical arts places electrical engineering apart from all the other engineering branches. An engineer whose education is based only upon practical experience cannot keep up with the progress and change resulting from it and falls behind; whereas a man with a knowledge of theory and a mind trained by the theoretical studies and by scientific study, easily grasps the theory of the change and readjusts his mind to the new without difficulty or delay. It is pointed out that of the electrical engineers prominent some years ago only those have retained their positions throughout the growth of the art who have persistently studied along theoreical lines. Mr. Buck believes that the best course of training for an electrical engineer is a broad course of education in general subjects at the preparatory school before entering college, with practical work, if possible, along lines of simple mechanics, such as carpentering, in order to train the mind into a sense of proportion and the relation of parts, which is the basis of all engineering. Next would be a college course with general subjects for the first year and for the remaining years of the course the principles having a direct bearing on the practice of the electrical profession. This should be supplemented with actual daily work with machinery operating by the principles taught and demonstrating all the phenomena incident to the theory. After graduation an apprenticeship is recommended in some large manufacturing establishment where the commercial relations of the knowledge acquired in college can be clearly set forth. After a few years of this training, specialization may be taken up along the line selected for the life work, but preferably he should acquire first a broad view point from which to make a correct start in the direction for which he is best fitted. This plan perhaps means a small income the year after graduation from college, but it means much more at the end of five years. Mr. Buck

points out that success in engineering not only implies a knowledge of theory and practice, but also includes intrinsic personal qualities. Stress is laid upon a training in the English language, for no man who cannot express himself clearly and easily in writing and in conversation can hope to attain a prominent position in his profession.

Prof. E. B. Raymond, in a paper entitled "A Proposed Reform in Technical Trainings," set forth views on engineering education in some respects radically different from those expressed in the other papers. One of the points of difference is that Prof. Raymond demands rather exceptional personal qualifications on the part of the student; for example, advocating that all studies be dropped from courses which are likely to be taken up after graduation, on the grounds that if properly trained the graduated engineer will devote a portion of each week to study, and will do this from a natural inclination to study.

The plan proposed is that when a boy enters the High School, either parent or teacher should decide upon his line of life work. For the boy in the High School who intends to be an electrical engineer, it is suggested that for about six weeks of his last two summer vacations at the High School, he should work in the machine shop of some manufacturing electrical concern. During his college course the student in electrical engineering should spend a part of each summer in similar practical work, supplementing it, perhaps, with work in a foundry or pattern shop. The draughting room at college would mean much more to such a man than to the ordinary student. From college electrical courses such studies as French and German, rhetoric and English composition, history, English literature and political economy could be dropped. In place of the studies discarded, more stress could be laid upon mathematics, physics, mechanics, chemistry, thermodynamics and the laws of electricity. There should be enough of these studies to give him, in addition to mind training, excellent detail knowledge of the subject studied.

The Moore Electric Light.

On June 10 eight patents were issued to Mr. D. McFarlan Moore on his system for producing electric light, these being in addition to almost a hundred patents previously granted him. We are enabled through Mr. Moore to present herewith the inventions embodied in these patents, as well as the ideas and aims held before himself by the inventor in the development of his ideas.

About seven years ago Mr. Moore gave the first exhibition of his system, and during this period it has been radically changed a number of times. His first experiments were with his "vacuum break" in connection with light production, the lamps used being glass bulbs with special internal electrodes, as shown in Fig. 1.

In 1896 long tubes were substituted for bulbs (Fig. 2), and in April

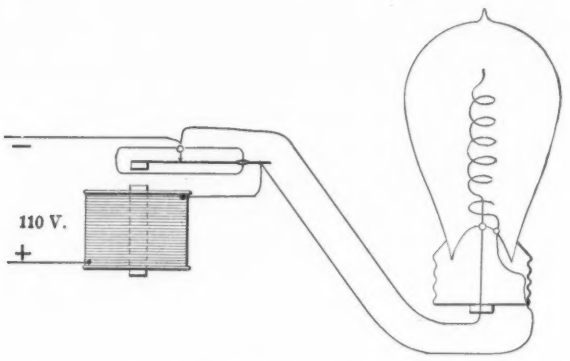


FIG. 1.—VACUUM VIBRATOR AND LAMP WITH INTERNAL ELECTRODES.

of this year he lighted the meeting hall of the American Institute of Electrical Engineers. The tubes were suspended from the gallery on all four sides of the hall. These same tubes were exhibited during the following month at the New York Electrical Exposition, where they attracted much atention. Some of the new features in these installations were the tubes, their operation on commercial circuits, the vacuum break employed, the production of brilliant effects without the use of any secondary coil, and the diminutive size of the apparatus.

At the New York Electrical show of 1898, at Madison Square Garden, Mr. Moore showed a "chapel," lighted by tubes which conformed to the architectural conditions. At this installation he had substituted a "rotator," shown in Fig. 3, for the former vibrator. This was a structure capable of accommodating at least 100 people.

Since the above and some later exhibits, Mr. Moore has radically improved his lighting system, and the light now produced is at least 25 times brighter, per square inch of tube area, than it was in the "chapel" exhibit, besides being perfectly steady.

The objection to the vacuum break for lighting purposes was that

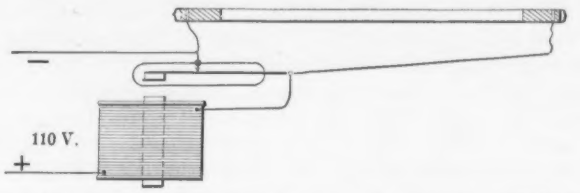


FIG. 2.—VACUUM VIBRATOR AND TUBE WITH EXTERNAL ELECTRODES.

mechanical difficulties limited the size, and a large installation would require too many "breaks" to be thoroughly practical. But Mr. Moore considered that its efficacy lay in the fact that it produced probably the most peaked wave ever obtained, and his next step was to design a dynamo that would give such a wave, and from which the tubes could be lighted directly, this of course, obviating limitations as to the number of tubes that could be operated in parallel from a generator of suitable size. This generator was the subject of several patents, the first dated March 6, 1900, and containing the following claim:

"As a means of producing illumination by the agency of electricity,

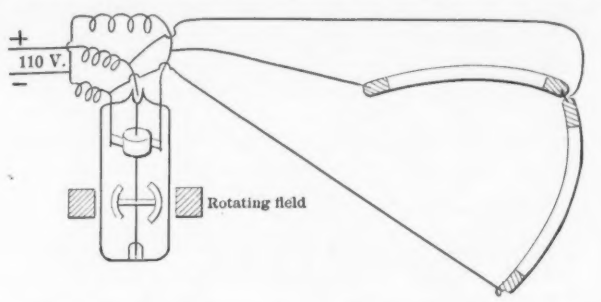


FIG. 3.—VACUUM ROTATOR AND TUBES WITH EXTERNAL ELECTRODES.

the combination substantially as described of vacuum-tube lamps having terminals of the character described and an alternating-current dynamo connected directly to said terminals and exciting said lamp to luminosity by the interrupted or continuous application of the alternating electromotive force generated by said dynamo as and for the purpose set forth:" (Fig. 4).

Another patent of the same date sets forth the details of the dynamo and system, while one dated July 9, 1901 demonstrates the great value of the peaked wave (Fig. 5). The patents just issued cover his latest system, which has an efficiency at present equal to that of the incandescent lamp and, furthermore, he has eliminated the necessity of a special dynamo and can produce brilliant vacuum-

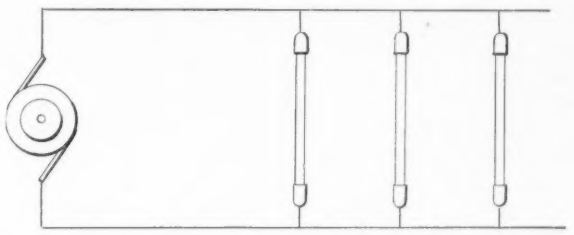


FIG. 4.—VACUUM TUBES LIGHTED DIRECT FROM DYNAMO.

tube illumination from the alternating street circuits without the use of any rotary apparatus. Two of these patents show this accomplished by using the standard eight foot tubes equipped with special caps and condensers, but a broad, and what is stated to be the most important patent of the series, discloses a system not only operative from street mains but designed especially for safety, efficiency and means which permit of increasing the intensity of the light to almost any point desired. Fig. 6 of the patent shows the salient points of this system.

Quoting from patent specifications, "The object of this invention is to avoid the use of electric conductors for distributing the electrical energy to the lamp or light-giving portions of the system,

and to thereby permit the illumination of buildings and contained areas without the presence of conducting wires or circuits of copper distributed through the building or the rooms thereof."

Briefly stated, the invention claimed by Mr. Moore consists of distributing or running a translucent tube or receptacle over areas, spaces or rooms to be lighted, the terminals of the tube being brought to a source of energy outside of the areas or spaces, or in a location where the terminals may be suitably protected against danger of contact or accidental interference, the tube containing a gas which is of such character or degree of rarefaction that by the application of electrical energy or current to the terminals of the tube it will be rendered luminous by the transfer of the energy from one terminal of electrode to the other. In the practical installation of the system the translucent tube of glass may be built up in the position it is to occupy while in use, or otherwise distributed as a tube of glass over the spaces to be illuminated and its terminals, which are provided with suitable energy transferring electrodes or caps, brought to a protecting cabinet or wall pocket, in which they may be connected to the two poles of the energy supplying devices, the latter being mains or wires leading direct from the primary generator of e. m. f., which might be the terminals of suitable transformers adapted to give the required secondary voltage. In practice alternating currents of greater or less voltage, as might be found desirable, would be used.

For illuminating the interior of a dwelling or structure, the portions of the glass tubing which contain the luminous column from which the effective illumination is obtained, would be distributed in any desired way throughout the whole interior of the dwelling or structure as one or more tubes, with the conducting caps or terminals thereof brought from within the illuminated spaces or areas

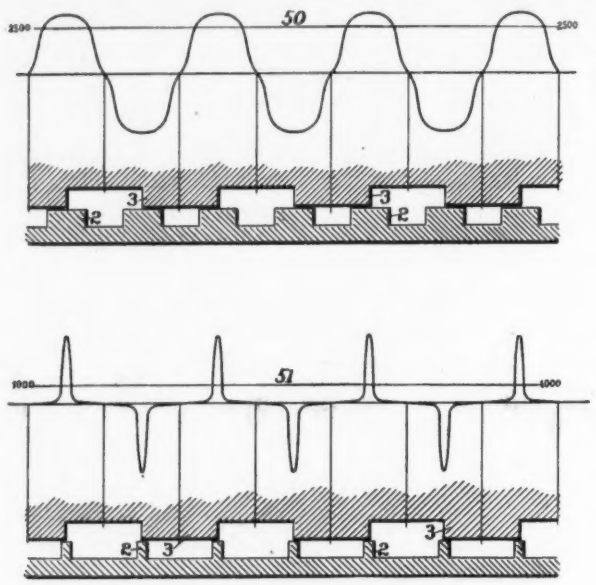


FIG. 5.—"PEAKED WAVE" DIAGRAM.

to an exterior cabinet or receptacle where its conducting caps would be located out of harm's way, and in immediate connection with the source of energy. Or if desired, the energy might be carried into a building and suitable transforming devices located in sealed wall pockets within the same, the terminals of the tube being located in the same manner in the pockets, while the luminous portion of the tube would extend over or through the areas to be lighted, being distributed in any desired form or manner therethrough.

Mr. Moore claims that while his invention may be carried out with any form of lamp having the characteristics above described, namely, a translucent receptacle and energy supplying electrodes at the terminals of the luminous column, he prefers to use for the purpose a form of lamp consisting essentially of a translucent tube whose conducting terminals or electrodes are metal caps or carbon paste attached closely to the exterior of the tube, and transferring their energy by electrostatic action to the contents of the tube itself.

Among the advantages claimed over the present systems of electric lighting are, first, the complete absence of fire risk even when the lamp is operated by high voltages, since it is not necessary to have any metallic conductors within the areas or spaces where danger from fire may exist; second, great economy in installation and in efficiency, owing to the fact that the amount of apparatus required is reduced to a minimum no lamps, and the absence of sockets, flexible cords or cut-outs, wires, moldings or conduits, etc.

Another form of the system consists in distributing with each of the former standard 8-ft. tubes a small transformer, but new type of "long-tube system" is claimed to have many advantages over this.

In many rooms the tubes will be like the picture molding, the absence of fixtures and spots of light being of great advantage both from an artistic and a utilitarian standpoint, because it permits of a practically unbroken or continuous line of pure white light, thus showing things in their true colors; extending as it would around or over the area to be lighted, there would be realizing what has long been sought for in electric illumination, namely, a perfect diffusion of light. Mr. Moore proposes the name of "artificial daylight."

Another of the patents refers to the practical installation of this system, dealing with such points as to the methods of building up such a tube from lengths of tubing short enough to be easily handled,

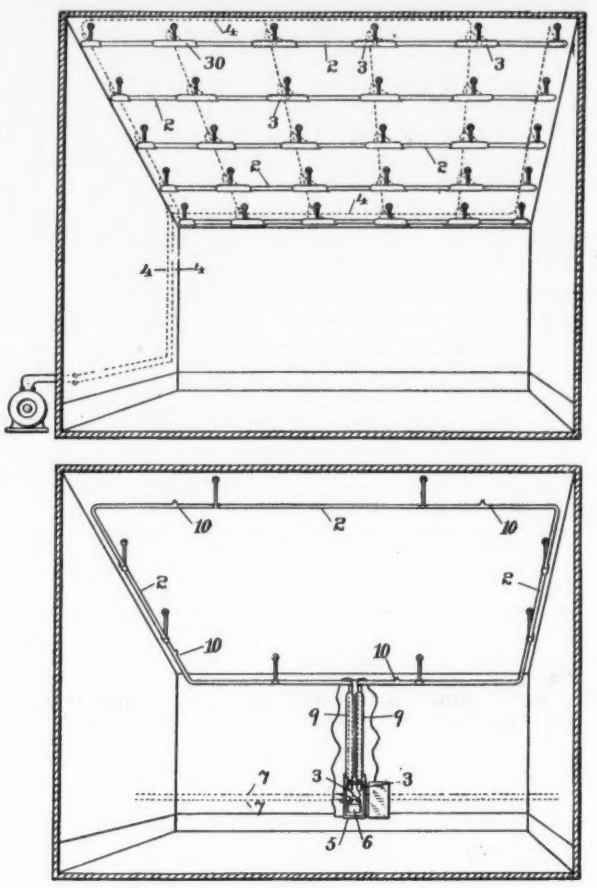


FIG. 6.—ELECTRIC TUBE LIGHTING SYSTEM.

and fusing them together end to end, or joining them in other ways. Mr. Moore has devised ways and means that are claimed to have obviated the many practical difficulties that presented themselves. This patent also deals with the methods of exhausting the tube and the insertion of certain chemicals therein. Another patent gives the details of construction of the terminals and of the terminal-box, one idea being to place it just as the ordinary "panel-board boxes" are now located in the wire ducts of buildings. Another patent deals principally with the efficiency of such a tube. It states that by lengthening out the illuminting gaseous column, that is, using a discharge column of high resistance, the watts per candle will be greatly decreased. For example, with a light column of, say 18 inches, available for illumination the watts were, with a given voltage and cap area, 15. But doubling the length of the light column reduced the watts per candle to 11, and increasing its original length eight times reduced the watts to 4. Mr. Moore for several months past has had a tube over 100 feet long in operation at the laboratory of the Moore Electrical Company, in Newark, N. J. Other tubes of various lengths have also been constructed and tested, all proving the practicability of producing light in tubes of great length, due to the fact that the system does not limit either the cap area or voltage or efficiency. A tube over 100 feet long run-

ning around the sides of a room and shedding a perfectly uniform light of 6 cp to the foot, is said to have an efficiency which varies somewhat with the density of the light—becoming poorer as the candle-power per foot becomes greater. Under some conditions there would be no practical objection to having tubes both around the walls and on the ceiling, and the total length of the tube, lighting a given area, would be such that it could be operated at low density and at about 2½ watts, but an average room can be well lighted by a "picture molding" tube alone at 2 cp per foot at 4 watts. As to the diffusion factor, a great advantage is claimed for the tube, as 16 cp from a source 3 inches long does not produce nearly as good an illuminating effect as 16 cp from a source 3 or 4 feet long. The nature of the tube is such that probably in the majority of installations it will be desirable to place a reflecting coating to the upper or back surface.

When the building to be lighted is furnished with alternating current, the only apparatus required is the tube and a small transformer, but if direct current only is available a small rotary transformer is also placed in the basement.

The illumination is perfectly steady and soft, and can be made of any reasonable intensity while daylight distribution and color values are perfectly produced. While in some cases the special transformer would impress upon the tube 10,000 volts, this voltage does not exist as "wiring" or "circuits," but is all confined to one small steel box, constructed perfectly, electrically, placed outside of the building, if so desired, and extending from it two glass tubes, harmless to either life or property. In the case of a suite of rooms, but one terminal box will be needed for all. In department stores, for example, continuous tubes hundreds of feet long would extend the entire length of the aisles.

It is claimed that so far as diffusion and the approach to daylight is concerned, this system will probably never be surpassed. Its color is white, not a harsh yellowish or red light like the incandescent lamp, but very close to diffused daylight. It is claimed, besides, to have a further advantage in that it is by far the coldest light yet made commercial, "all the other lights in comparison being simply "hot spots," and is suitable for all kinds of illumination; in fact, wherever the incandescent lamp is now used, it is applicable; even streets can be lighted over their whole lengths, not as now in intensely bright 50-ft rings. The tubes can be made of heavy, strong glass, but if they should be accidentally broken they can easily be repaired. It is "wireless" light. You can go into your house and leave pitchy blackness behind you, and after you have shut the door not know, except by memory whether it is noon or midnight. It is light, not lights, and oculists and photographers will be interested.

Another point claimed is that in a room thus lighted there are no shadows and no glaring reflections such as are now always present at certain portions of artifically lighted oil-paintings; therefore, this light is of the highest value in art galleries. By simply changing the character of the gas in the tube, an apartment can be bathed in many successive shades of color, producing results unattainable heretofore, since there is beauty and brilliancy without glare and light, rich with most delicate tints of color that can be made to harmonize perfectly with drapery of any conceivable style.

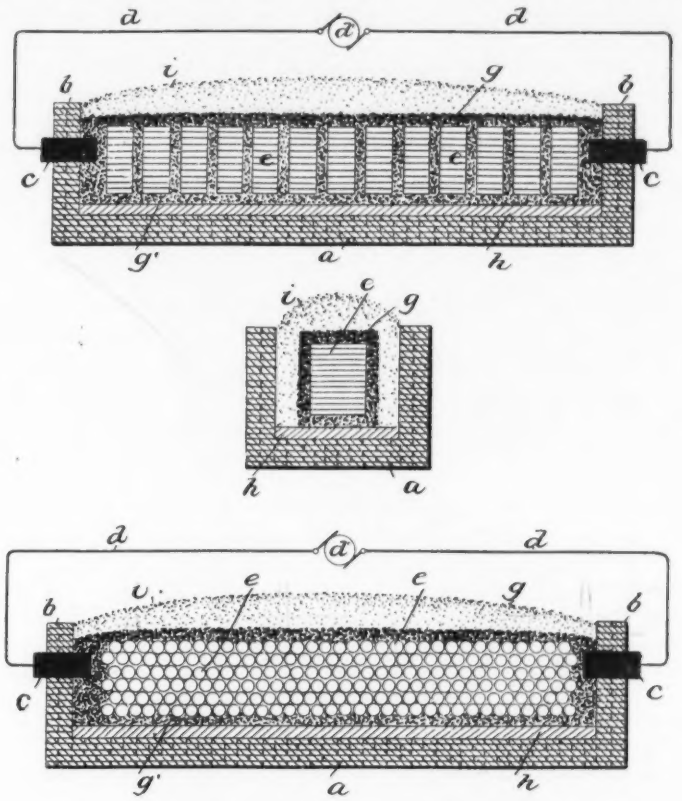
The inventor states that although in many commercial installations, the simple straight tube will be desirable; nevertheless, it is far from the fact to assume that the light is therefore strictly confined to such a tube, for it can actually be fashioned by the glass blowers' art into almost any conceivable size or shape, and, therefore, the field of artistic lighting is far wider than ever before. The tubes, if desired, can be made up in the form of letters of the alphabet, either Roman or script, and 25 feet high if necessary. They have, therefore, a valuable application for advertising purposes. Electrical advertising signs, as constructed at present with incandescent lamps, consume a great deal of current, and their first cost is also high. It is maintained that the Moore tube-signs will consume a far less amount of current and are much lower in first cost, and have the advantage that the letters can be removed at will, thus permitting the sign to be changed to any desired reading. Signs about a foot high and four or five feet long can be used in show windows simply by connecting them with a flexible cord from an incandescent lamp socket. They would be operated by the latest form of the Moore vacuum-break, which is also the subject of one of the patents just issued. Its main advantages are reliability, cheapness and life. The total wattage used is claimed to be almost ridiculously small, as compared to a similar sign made up of incandescent lamps, for example, a sign as above used 7½ watts. Mr. Moore has long contended that this vibrator will be of great utility in X-ray work and wireless telegraphy.

Graphitizing Electrodes.

BY CLINTON PAUL TOWNSEND.

In the issue of the ELECTRICAL WORLD AND ENGINEER for April 6, 1901, the writer discussed the historical and commercial aspects of the artificial graphite industry; and in an issue of the current month a description has been given of one of the great terminals of the furnaces now in use. Mr. Acheson, in his latest patent, gives a full and complete disclosure of the present method of graphitizing electrodes and other formed articles at the works of the International Acheson Graphite Company, in Niagara Falls.

The principle is simple; any form of carbon containing impurities in sufficient quantity and of suitable kind may be graphitized. The recation seems to occur through the intermediary of the carbides, and in consequence the impurities present must be of a character capable of combining with carbon, in quantity sufficient to determine the conversion to the extent desired, and the temperature must be



FIGS. 1, 2 AND 3.—GRAPHITIZING ELECTRODES.

above the point of decomposition of the carbides formed. The reaction being progressive, the amount of carbide-forming constituents actually present is relatively small.

The necessary temperature is developed by the electric current, and the present patent deals with the mode of application of the current, the improvement recorded being two-fold in character. Articles to be graphitized are placed in the furnace with their longest dimensions transverse to the direction of flow of the current. If their form be other than cylindrical, they are arranged in vertical piles, separated by powdered coke. Cylinders may be placed in contact, the single contact line reducing the current path sufficiently to develop with economy the required temperature.

The accompanying figures show in longitudinal and transverse vertical section the furnace operating upon a charge of rectangular electrodes; the lower figure indicating the arrangement of cylinders. The furnace comprises a base, *a*, and end wells, *b*, of fire-brick, carbon terminals, *c*, and line connections *d*, *d'*. A bed of carborundum or other refractory conductor, *h*, is laid upon the base and upon this rest the transverse piles, *e*, of the formed articles, the retangular shapes separated, as shown by thin layers of ground coke, *g*, and the cylinders, as indicated in Fig. 3, in lateral contact. Thin layers of

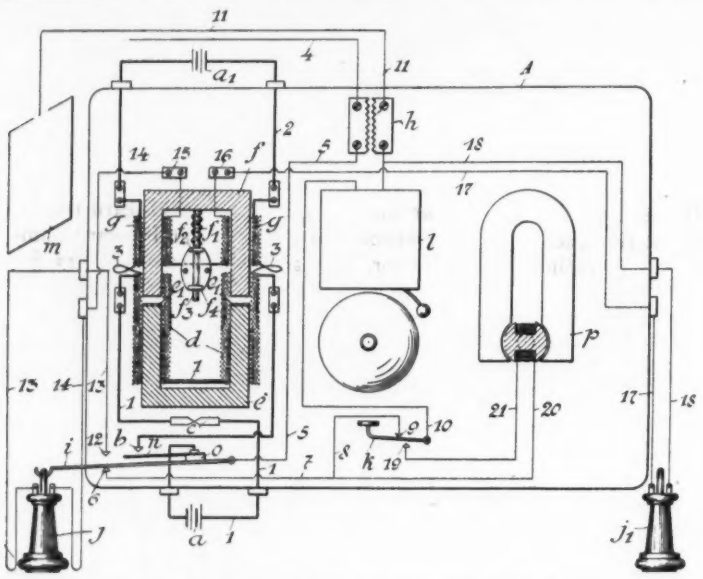
the same material underlie and cover the piles, and a filling of ground coke and sand is placed around and over the conductive charge.

It might be considered a matter of small moment whether the articles be placed parallel or transverse to the lines of current flow; in fact, however, this simple change represents a distinct principle of operation, for it means that the heat is no longer developed within the body of the article but exterior thereto, and either in the separating layers of coke or in the single contact lines of the cylinders. That this represents a very considerable economy of current is apparent from the fact that the cross-sectional area of the terminals may be actually less than that of the conductive bed, the relation between these areas being stated as 100 to 102.

New Telephone Patent.

The solitary telephone patent of the issue of June 17 is a contribution from Austria-Hungary, Mr. Franz Oprendek, of Vienna, being the inventor, and the device, a "sound-strengthening appliance for telephone stations." Telephony is not in a very advanced state in Austria-Hungary, and while the telephones there may be sorely in need of sound strengthening appliances, we hardly think that Mr. Oprendek's method supplies the solution of the difficulty. By turning the induction coil of a telephone transmitter into a horseshoe electro-magnet and supplying this magnet with a horseshoe armature, resting on a spring support which allows of a reciprocal motion of the armature, Mr. Oprendek aims at producing alternating currents by reason of the reciprocating action between the magnet and armature, which will be of the same form as the telephonic currents that cause the reciprocating action and will strengthen those telephonic currents. This sounds a little like perpetual motion or a man lifting himself by his boot-straps, but that reproach is avoided by the use of magnetizing coil on the reciprocating armature energized by a primary battery separate from the transmitter battery.

In the drawing, which incidentally shows that it is Austro-Hungarian practice to use an ordinary trembling bell with a magneto-generator, *e* is the induction coil magnet and *f* the horseshoe armature, upheld by spring f^1, rod f^2 and brackets f^3 f^4. The action of this remarkable device is best described by the inventor himself.



SOUND-STRENGTHENING APPLIANCE FOR TELEPHONES.

"Supposing the primary circuit 1 to be closed, the core *e* will be magnetized by the coils *d*, and when the microphone *c* is spoken to the resistance of the circuit will vary, and the variations of the strength of the current thereby caused will also produce variations of the magnetic force. By the magnetic force the armature *f* is moved toward the core *e*, the poles of which are covered with disks, e^1, of cotton or paper, by which immediate contact and permanent adhering of the armature is prevented. While the armature *f* moves toward the core *e*, it compresses the coiled spring, f^1, and stores power in the same, and as soon as the magnetic force diminishes, the stored power acts for lifting the armature. By the following increase of magnetic force the armature *f* is again caused to move toward the core *e*, and so on.

"If the work of repeatedly attracting the armature, *f*, and compressing the spring f^1 were to be done at the expense of the energy of the current flowing through the primary coils of the bobbins, *d*, the said current would thereby be weakened, and consequently the induced current, too, by which the telephone receivers are actuated. Now, in order to attain the object in view, which is to strengthen this latter current, I provide a special galvanic battery, a^1, for supplying the energy required for reciprocating the armature *f*. By two bobbins, *gg*, having their thick wire coils included in the circuit 2 of the battery a^1, the armature *f* is so magnetized as to oppose unlike poles to the poles of the core *e*. Every time the armature *f* moves toward the poles of *e*, and thereby puts the spring f^1 in tension, energy is spent by the current flowing through the primary coils of the bobbins *dd*. Consequently an alternating current of the same form and phase as that induced in the secondary coils of the bobbins *dd* will be induced in the secondary coils of the bobbins *gg*. This current can, therefore, be utilized for strengthening the current flowing through the line, this being obtained by connecting the secondary coils by wires 3 3. The effect of this strengthening of the secondary current is different from that which would be obtained by strengthening the galvanic battery *a*, as in the latter case too strong a primary current would flow through the microphone *c*, which thereby would be heated and deranged in its normal operation.

"A further strengthening action upon the secondary current for louder transmission is obtained by extending the bobbins *dd* beyond the poles of the core *e*, as shown, and arranging the ends of the armature *f* within the extended bobbins *dd*. The magnetized armature *f* oscillating within the bobbins *d* induces in the secondary coils alternating current waves, and as the oscillations are in unison with the undulations of the primary current flowing through the microphone, the said alternating current adds itself to the alternating current induced by the undulating current. As in this action the ends of the armature *f* are intended to act upon the secondary coils of the induction bobbins *dd*, the extended ends of said bobbins have the secondary coils of thin wire arranged inside the primary ones, while in the lawer portion of both bobbins *dd*, intended to magnetize the core *e*, the primary coils of thick wire are arranged inside, as usual."

From all of which it appears that the telephonic art in Austria-Hungary is not quite up to the mark reached in these United States.

Electric Light and Power in Venezuela.

U. S. Consul Goldschmidt, at La Guayra, reports that there are three electric plants run by water in Venezuela; the principal one is located at El Encantada, 10 miles from Caracas. During the rainy season it develops 400 hp, but from December to April this is reduced to 100 or less, as in the dry months the water is used for irrigating the adjoining lands. This enterprise was organized in 1897, with a capital of about $200,000 gold. Three vertical turbines are employed, and the generators are alternating current, and develop pwer of 5,000 volts. Most of the apparatus is of Swiss manufacture; the wire came from Italy. The power developed is used by small corn mills; also by printing offices, coffee mills, etc. At night, it is employed to light Caracas, 12 cents per hp per night being paid for this purpose. The other industrial concerns pay from 30 to 50 cents per hp per day of ten hours. The company is now erecting a new plant, 1¼ miles farther away, at a point where there is a waterfall of 300 feet. When this new station is finished, the company expects to obtain 1500 hp.

Another enterprise is at Merida (State of Los Andes). This was established about two years ago, to light the city; only about 150 hp is developed. All the machinery is of American make, and direct current.

San Cristobal (Los Andes) has an electric station of 200 hp to light the city and furnish power for a few industrial concerns. A small plant at Barquisimeto, with French machinery, stopped running two years ago.

The following electric plants have steam as motive power:

Caracas.—Compania de Gas y Luz Electrica de Caracas; capital, $443,900; 300 hp; uses patent fuel, 4 tons daily, and 7,350 gallons of water. The plant has a capacity of 96 arc lamps of 2,000 cp used in the streets, and 4,000 Edison incandescent lamps of 16

cp. For arc lights, 50 cents is paid per night of six and one-half hours; for incandescent, $1.80 per month.

Maracaibo.—An electric plant furnishes light for 300 arc lights of 1000 cp. and about 4000 incandescent lamps. Fuel being cheap, the price of the latter is 80 cents per month for all night.

Valencia.—A plant furnishes electric power for 60 arc and 600 incandescent lights.

Puerto Cabello.—A plant furnishes power for 50 arc and 300 incandescent lights; the arc lights are of 800 candle power.

La Guayra.—The plant has not been used for some years; and is in bad shape. An effort was made a year ago to start a new company, but nothing has been accomplished.

Commencement Honors.

At the commencement exercises at Harvard University, Wednesday, June 26th, President Eliot conferred the honorary degree of M. A. on Mr. Charles Proteus Steinmetz and Mr. Francis Blake, the inventor of the telephone transmitter. Prof. Brainerd Kellogg, of the Brooklyn Polytechnic Institute, was honored with the degree of LL. D. by Middleboro College the same day, and Yale conferred the degree of M. A. on Mr. Henry G. Prout, editor of the *Railroad Gazette*.

CURRENT NEWS AND NOTES.

THE NAVAL ACADEMY at Annapolis is being fitted with a 170-foot wireless telegraph mast. Prof. Terry is equipping a wireless telegraph station for instruction purposes.

GIFT FROM MR. WESTINGHOUSE.—It is reported that Mr. Geo. Westinghouse will present the Western University of Pennsylvania with a complete electrical equipment for the new observatory, now nearing completion in River View Park, Allegheny, Pa.

THE NEW GERMAN CABLE.—A cablegram from Berlin announces that the first section of the new German Atlantic cable, from Borkum to the Azores Islands, will be completed by Dec. 31, 1903. The second section, from the Azores to New York, will be laid between that date and Dec. 31, 1904.

PROF. HENRY A. WARD, of Chicago, has recently returned from Mexico, and will shortly publish a full account of a 50-ton meteorite just found there in the volcanic region near Cohina. Pieces of it have been secured by blasting with dynamite. The total size is 13 ft. 1 in. in length, 6 ft. 4 in. thick, and 5 ft. 4 in. wide.

WIRELESS TELEGRAPHY IN THE SOUTH SEAS.—It is announced from Los Angeles, Calif., that John D. Spreckels is contemplating connecting the Hawaiian Islands by wireless telegraph with San Francisco. Spreckels has refused to become the backer of a cable to Hawaii, because of his faith in wireless telegraphy.

GERMANY AND SCIENCE.—In an address made June 20, by Emperor William, of Germany, at Aix-la-Chapelle, that sovereign made the statement that the Germans were the first to employ discoveries in science, and others only copied them. This remark was made during one of the Emperor's religious-patriotic-histrionic outbursts, and doubtless was highly appreciated by those Germans who are as little informed on the subject as the Emperor himself.

WIRELESS TELEGRAPHY IN THE BRITISH NAVY.—Notwithstanding all of the reports to the contrary, it seems that the British naval authorities have not yet found a satisfactory system of wireless telegraphy. It is stated that it was intended to have communication by means of wireless telegraphy between the various ships that are to take part in the coronation review, but that the idea had been abandoned "for the reason that the system has not been found sufficiently reliable by the navy."

FROM THE FORECASTLE TO THE TROLLEY.—The Navy Department is feeling some concern over the demand on shore for the services of enlisted men who have obtained experience in the mechanical and electrical departments of warships. The warship of the present day has become little more than a vast aggregation of machinery, and enlisted men who gain experience in connection therewith find, upon the expiration of a cruise, abundant demand for their services ashore at a remuneration and under conditions vastly superior to those of naval service. Recent developments render the situation still further unsatisfactory to the naval authorities, due to the opportunities which offer to the unskilled of the enlisted force for employment by trolley companies. It has been found that landsmen and others who have served abroad warships, by reason of their subordination and schooling in discipline, make ideal electric railway motormen.

TROLLEYS FOR MALAGA.—U. S. Consul Benj. H. Ridgely, at Malaga, Spain, says: The municipal council of Malaga has finally authorized the company operating the street-railway system of this city to apply electric traction to the several lines. The mileage of the company at present in operation is comparatively insignificant, consisting of only about eight miles, but concessions have been granted for various other streets, and the system is sure to expand considerably at no distant day. The company owning the system is a joint-stock society, with headquarters in Brussels, Belgium. The corporate name is "Tramways of Malaga." The directors are Messrs. Adh de la Hault, P. Hammebeath, Charles A. Lucas, Paul Mayer and Max Ryndzunsky, all of whom reside in Brussels. It is said to be the intention of the company to go to Germany for its entire electric equipment. It is possible, however, if the matter were thought to be of sufficient importance, that enterprising American agents might interfere with this plan.

ENGINEERING AT HARVARD.—The Harvard Engineering Society has issued the first number of the *Harvard Engineering Journal,* a quarterly, devoted to the interests of engineering and architecture at Harvard University. The first issue, which is dated April, contains an illustrated description by Prof. I. N. Hollis, of Pierce Hall, the new engineering building. Assistant Professor James Lee Love gives a history of engineering at Harvard University, and Prof. Lewis Jerome Johnson writes on instruction and engineering at Harvard. The number also contains a lecture on "The Steam Loop and Holly Gravity Return System," delivered before the Harvard Engineering Society by Mr. Chas. Gilbert Wilson, and the first part of an article on storage batteries, by Mr. Philip Whitney Davis. From the article by Prof. Johnson we learn that at present the teachers in the division of engineering at Harvard number 24, including one professor, five assistant professors, 13 instructors and five assistants. Since then Dr. A. E. Kennelly has been appointed a member of the engineering faculty, with title of Professor of Electrical Engineering. The students of engineering are registered in three different branches of the university, and thus the only adequate means for stating the extent of the interest in engineering at Harvard is to specify the total number of enrollments in its courses. This number for 1900-01 was 1,252, which places the division of engineering third in this respect among the 14 divisions of the faculty of arts and sciences. In making this count, enrollments in half courses have been given, in all cases, half the weight of those in full courses. In total number of full courses or equivalents offered, the division of engineering ranks fourth with 28.5 study courses.

LETTER TO THE EDITORS.

Hand vs. Machine Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs.—Permit me to make a few comments on the communication of Mr. F. W. Jones regarding the telegraph, printed in your issue of May 31st.

Mr. Jones starts out by stating that he has "no client to defend," meaning, of course, that the criticisms passed upon the Western Union by Prof. Pupin do not apply to his company. Concerning this view, readers of Prof. Pupin's statement may judge for themselves. Having decided this question to his own satisfaction, however, Mr.

Jones puts himself in the position of prosecuting attorney against all methods outside of his company's patronage, and for proof that automatic telegraphy is not as good as the Morse, reference is directed, by chapter and verse, to a gospel paper read by him *five years ago* before the American Institute of Electrical Engineers. It is seldom in these days of progress that one can so complacently refer back five years to a final dictum which all further discussion must only illume as immutable.

Somebody has said that "men's judgments are a parcel of their fortunes"; hence, I presume, the importance attached to them by their possessors. It is well known to all telegraphers that the most important advances thus far made in automatic telegraphy have been brought about within the past five years.

The sum of Mr. Jones' conclusions, concisely stated, may be said to be: that outside of the hours 10 to 3 the telegraph companies have an excess of facilities, and outside of 8 to 5 have wires "to burn."

That the public have the privilege of half-rates, which they use only very sparingly, at which Mr. Jones does not wonder, owing to our excellent mail service.

That "no automatic system has been invented that obviates the expensive and slow preparation of telegrams by special codification and manual manipulation at the sending end, and the special translation and manual transcription at the receiving end," and that not until somebody invents and the companies reject a system wherewith "customers" messages could be thrown into a hopper in New York and come out of a machine in Chicago at the rate of 500 or 1,000 words a minute, correctly printed on blanks and ready for delivery," can the companies be justly charged with old fogyism.

That, indeed, the telegraph owners would be foolish not to adopt such a system, and the nearest approach to this ideal arrangement, in Mr. Jones' opinion, is the work performed over a quadruplexed wire of his company, between New York and Boston, which for 21 days in April, nine hours working, showed a daily average of 41.26 messages per cicuit per hour, or 80 words per minute all told.

Taking these propositions in the order of their arrangement, we have first the admission that the telegraphs are primarily conducted for, and are almost wholly dependent upon the speculative market between the hours 10 and 3, the remaining hours, the four hours 8 to 10 and 3 to 5, evidently being occupied in clearing up the ordinary business of the day which is not of such great urgency, or which has been pushed aside for the broker business, and that the remaining 15 hours of the 24 are unprofitable, principally owing to the competition of the post office.

It is well known, however, that in practice this schedule of operation is seldom realized. No company has more wires than they can fill between 10 and 3. Interruptions start the work of segregation of facilities about in this order: Stock and other exchange wires, leased wires, pool-room wires, cable service, newspaper specials, and, lastly, the business of the unpreferred general public. This latter traffic pushes the full-rate business into the half-rate hours, or into competition with the "sufficient despatch" of the mails.

I have always maintained that the Morse system was the best for exchange business, but the conduct of the telegraph shows that the companies have erred in going upon the principle that this was the only business worthy of quick service, for which is charged a heavy rate, and that all other business, although paying the same tolls, must give way and take its chances.

Taking the two facts that when the wires are all in order they are filled between 10 and 3, and that it is seldom they are all in order, would it not be better to increase the carrying facilities of the remaining wires in proportion to the occurring interruptions, so that no serious congestion could ever exist, rather than place all reliance upon a system circumscribed and inelastic in capacity?

Mr. Jones' remedy would be to construct lines that would never break down, using two and sometimes three poles where one now sustains the burden. That substantiality should be the first aim all must agree, for not even the "hopper" system could be relied upon further than the stability of the lines; but I submit that the course of the telegraph management has been altogether wrong for the past thirty years, and Mr. Jones' advocacy of its continuance and extension at this time is a discouraging sign for the future.

I think it but fair to assume that the policy of hand working and high rates was in a large measure forced upon the telegraph management by the construction of opposition lines, which the main organization felt compelled to buy up from time to time in order to continue a monopoly. In this way stock dividends were vehicled so that $1,000 of telegraph stock in 1858 represented $150,000 of stock and cash dividends in 1890. If the telegraph had been under Government control no such wild-cat construction would have taken place, but instead, substantial lines, operated to their highest capacity, and at low rates, would have developed a telegraph business covering all branches of commercial and social correspondence, and in volume probably twenty times greater than the present restricted traffic.

Where, under present restrictive conditions, the half-rate in no case falls below 20 cents for 10 words, or about 50 per cent. more than what the full rate should be, is it surprising that the public finds small inducement for filing half-rate messages one day for delivery on the day following? People, doubtless, take Mr. Jones' view that the "sufficient despatch and secrecy" of the mails at 2 cents is preferable.

With an automatic system these messages could all be delivered on the same day, and as it costs no more to deliver on one day than another, the public would have the benefit. The present rule forbids the delivery of a half-rate message on the same day, so as to force full payment or submission to the 12 or 15 hours' unnecessary delay. So long as the companies impose this penalty they should at least refund half on all full-rate messages left undelivered until the following morning; for could the sender have foreseen that his telegram would not be delivered on the same day he would naturally have chosen the half-rate plan, or availed of the "sufficient despatch and secrecy" of the post office.

Coming now to the most serious part of Mr. Jones' argument against automatic telegraphy, "slow preparation by special codification and manual manipulation at the sending end, and the special translation and manual transcription at the receiving end, with machinery more complicated than the Morse," here is evidently a plaint over sad experience; but it is not right to hold true automatic telegraphy responsible for a "hopper" disappointment. It is another case of basing a specious argument on spurious premises, to which I took exception in a previous letter.

Briefly stated, automatic telegraphy of to-day is operated as follows: Messages are perforated in Morse code on a simple machine controlled by a Morse key and Morse operator, the work being precisely the same as sending a message over a wire by Morse, with the exception that being a purely local operation, it is never interrupted by "breaking" or line trouble, therefore yielding a higher average speed.

Message tapes are automatically reeled up as they come from the perforator, these reels are handed to the tender of the transmitting machine, where the tapes are run through at any rate desired up to the carrying capacity of the line, which between longest and shortest distances in this country would vary from 100 to 3,000 words per minute. At the receiving station the messages are recorded in plain Morse characters on a tape and automatically reeled up. This reel is handed to a typewritist for transcription, and is printed at an average speed of 20 to 25 words per minute.

The work of perforating is exactly the same as now performed in sending by Morse, and the only difference at the receiving end is in transcription, which is done by sight instead of by sound. The only additional labor lies in the transmission and reception of the message, requiring a machine tender at each end of a line carrying at the lowest estimate, including starting and stopping, as many messages as ten quadruplexed wires, or 40 Morse circuits manned by 80 of the most expert sound reading operators. The cost of the automatic machine tenders would be much less than the expert adjusters required for ten quadruplex sets.

Now, as to the additional delay ascribable to the automatic process, and assuming that in order to keep the wire speed up to the proper standard it would be necessary to handle messages in "takes" of 5, or units of 150 words. Each unit could be easily perforated and placed on the wire in 7 minutes, and could be transcribed by typewriter in 7 minutes more, or say an average of 15 or 16 minutes from the receiving window to the delivery clerk. Owing to the great carrying capacity of the system this average time can be maintained under all conditions of weather. Does the present exclusive Morse methods of handling telegrams do as well? It is well known that the average time at present is over 30 minutes. Exchange business could, of course, be carried on by the Morse, and in time of interruption to lines be greatly expedited by the automatic.

In proudly citing what he considers a great performance of the

quadruplex, 20 words per minute for each circuit over the New York-Boston line, Mr. Jones omitted to mention that this quadruplex is worked on the "piece" plan, which recognizes that 250 messages (14 words per minute) is a full day's work, all messages over that number being paid for at the rate of one cent each. In order to make time the sending operator is allowed to abbreviate or code his messages, the receiver being relied upon to construe the pidgin English correctly. This advance of six words per minute over the standard 14, using a copper wire 250 miles in length, or a total of 80 abbreviated words, marks a long hiatus to the "hopper" system of 500 to 1,000 words a minute already printed, New York to Chicago, the refusal of which achievement would, in Mr. Jones' opinion, alone justify the charge of unprogressiveness against the telegraph companies.

Eighty abbreviated words per minute, constantly increasing wires, with two or three poles for one, presents a rather gloomy forecast for the future of telegraphy from the viewpoint of the electrician of a great company.

A more encouraging outlook is afforded in the contemplation of 30 perforating operators grouped around a single transmitter preparing messages, and 30 transcribing operators grouped around a receiver, all kept busy by a single wire, each pair representing a phantom circuit superior to the average quadruplex circuit. The well known fact that a system capable of this performance has been in operation to the extent of traffic requirements not a hundred miles from New York for the past eight months, confronts the critics of automatic telegraphy with a condition, not a theory—a daily practical demonstration, and one which during the sleet troubles last winter kept traffic clear over a wire subjected to interruptions of a frequency precluding the "balancing" of a quad once throughout an entire day.

You have hit the nail on the head and clinched it at the point in your editorial comment, May 24th, "if the birth of telegraphy had been delayed 40 or 50 years one does not venture much in saying that its evolution would be along entirely different lines than in the past, and, furthermore, that these lines would be fixed by the exigencies of automatic or machine telegraphy."

SOUTH ORANGE, N. J. PATRICK B. DELANY.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-Current Dynamo Design.—R. KENNEDY.—An article in which he gives the following formula. The total magnetic flux through the armature in Kapp lines is 200 times the square root of the kw-output; 200 is "a constant which different dsigners may alter in value according to their skill"; the lower it is, the cheaper the machine; the higher it is the better the machine. This formula assumes a speed of 1,000 per minute; for other speeds another factor must be used instead of 200. For lower speeds multiply 200 by the square root of the ratio of 1,000 to the given speed; for instance, if the speed were to be 250, then the constant instead of 200 becomes 200 times the square root of 1,000—250, *i.e.*, 400. For higher speeds than 1,000, divide 200 by the square root of the ratio of the given speed to 1,000; thus for a speed of 4,000, the constant instead of 200 becomes 100. When the constant has thus been determined, the total magnetic flux through the armature in Kapp lines is found by multiplying it by the square root of the kilowatt output. "All the rest of the design can now be left to any designer with some experience and a book of reference tables of iron and copper materials." Lond. *Elec. Rev.*, May 30.

LIGHTS AND LIGHTING.

Cooper Hewitt Lamp.—VON RECKLINGHAUSEN.—An illustrated article, in which he first gives a historical summary of previous experiments made with mercury vapor lamps and then describes the Hewitt lamp and discusses the properties of the lighted lamp, the process of lighting, the phenomena at the electrodes, the efficiency and color. The efficiency is much better than that of any other artificial source of light. In some cases an efficiency of one-third watt per candle has been obtained without the resistance in series, and 0.4 watt per candle with the resistance. The Hewitt lamp will have great importance for photographic purposes. A great advantage is that its light is not tiring to the eyes, and it is, therefore, suitable for drawing, reading, etc.—*Elek. Zeit.*, June 5.

REFERENCES.

Arc Lamps.—KOERTING, ROSEMEYER, STOECKHARDT.—Three controversial communications concerning the relative advantages of the Regina enclosed arc lamp and the ordinary open arc lamps.—*Elek. Zeit.*, April 3, May 1, 22.

Incandescent Lamp.—A well illustrated article on the incandescent electric lamp, how manufactured and tested.—*Sc. Am. Lup.*, May 24.

POWER.

Chilean Power Transmission.—RABY.—An illustrated description of an electric transmission plant for supplying power to coal mines in Chile. The power station contains two Pelton wheels of 400-hp each, driven at 214 revolutions per minute, direct connected to two 215-kw three-phase alternators. The current is generated at 400 volts, transformed up to 10,000 volts, and transimtted over the line of 2.3 kilometers length to the mines, where it is transformed down to 500 volts. Electric power is at present used in two pits. In the one the alternating current is converted into direct current for supplying three electric locomotives of 15-hp each, and for lighting. At the other pit, the current is taken down as alternating current, for operating two 2,000-gallon pumps, one 50-kw winding engine and a 36-hp motor, to work an endless chain.—*Jour. of Elec.*, May.

Fuel Oil in Power Plants.—REED.—An abstract of a paper read before the Southwestern Gas, Electric and Street Railway Association, at San Antonio, Texas, April 18, and a discussion of the same subject by F. C. Bitgood. Mr. Reed claims that the Houston Lighting and Power Company, with which he is connected, has had very satisfactory experience with the use of oil, and that they have found that it increases the steaming capacity of boilers in the neighborhood of 35 per cent. The paper enumerates many advantages growing out of the use of oil for fuel, and claims that a saving of 63 per cent. in the fuel bill was effected by the substitution of oil for coal in the Houston plant. It is mentioned, too, that steam can be raised much more quickly with oil burning under the boilers than with coal, but it is pointed out in this connection that there is a danger attending this practice, because of the liability to abuse the boilers by overcrowding them and attempting to get up steam quickly at the expense of the boiler. Mr. Bitgood relates the experience of the Hartford Company in the examination of plants in which oil is used. He calls attention to the injury done to boilers, but admits, with proper care, the wear and tear upon the boiler structure is probably less with oil than with coal.—*St. R'y Jour.*, May 10.

Steam Equipment for Turbine Plant.—A description of the boilers designed for the Cleveland & Southern Railway Company's power plant. The boilers will comprise three sets of 500 hp. each. The superheaters are guaranteed to superheat 150° F. It is proposed to install a stoker for feeding powdered coal if possible.—*St. R'y Jour.*, May 10.

REFERENCE.

Irregularity Factors of Engines.—FRANKE.—The first part of an illustrated reprint, in full, of his German paper "on the determination of irregularity factor engines," which has been noticed before in the Digest.—Lond. *Elec. Rev.*, May 30.

TRACTION.

Electric Railway Practice on the Continent.—VELLGUTH.—A very comprehensive article, reviewing the entire situation in the matter of transportation for cities and also suburban traffic in continental

Europe. It is profusely illustrated, and contains views of special features of construction that are characteristic of the principal continental cities. The conditions of practice, which are universal throughout continental Europe, and differ from those of America, are enumerated as follows: Smaller traffic, lower wages and different labor conditions, smaller money unit, difficulties in the way of operating companies through the indifference of municipalities on the pretext of insuring safety and because of their policy of extorting absurdly large fees for franchises and rights of all kinds. This has seriously interfered with the development of electric traction throughout Europe, and has crippled the service where lines have been built. No European city can show traffic approximating that which exists in large American cities. Berlin is far behind New York; the Grosse Berliner Strassenbahn alone, without counting its leased roads, carried, in 1900, 236,300,000 passengers, and in 1901, 306,300,000. The municipalities impose very harsh conditions upon the companies in the matter of contributing towards the general expenses of the city. Very small cars have been adopted in most European cities. A car seating 20 passengers, with standing room for a few more, is the maximum, while most of the cars accommodate not more than 16 passengers. The most annoying features are those which arise from the supervision exercised by the municipalities over the construction and operation of the roads. It is not at all uncommon, for instance, to have a car equipped with three kinds of brakes, namely, the hand brake, short-circuit and magnetic brake, and, perhaps, also a track shoe-brake. Aesthetic considerations also require expensive poles with highly ornamental brackets, and have even induced the municipalities to prescribe accumulator service in fine residence districts by prohibiting poles in these sections. Accumulator cars have been forbidden by the Prussian Minister of Public Works in the cities of Berlin, Hanover and Hagen. The companies are burdened by the restrictions imposed by the state for the protection of the telephone systems, which are generally controlled by the government. After a general review of the situation in all of the continental countries, the author describes in this series the special features characteristic of the standards adopted in Germany, France, Switzerland and Holland. A very vigorous effort has been made to substitute the bow trolley in general practice for the trolley wheel, and the latter is now preferred by many managers of large roads; the chief drawback, however, has been the fact that most of the principal roads had already adopted the trolley wheel, and any change would necessitate the discarding of a large number of these devices and also necessitate a change in overhead construction. Several of the roads have taken up the subject of freight traffic, but this branch of the business has not been very generally followed. In Germany, there are no three-phase roads, excepting the high-speed Zossen Railway, on which the 200 km. per hour experiments have been made. It is quite general practice, however, to use three-phase transmission with rotary substations. The most extensive electric railway system of Germany, and in fact of all Europe, is that of the Grosse Berliner Strassenbahn, which controls the entire traffic of Berlin, with the exception of three small lines, and operates 53 km. of tracks, passing through 27 km. of streets. Nearly all of the lines of the company are electrically equipped. The rolling stock consists of 2,529 passenger cars, including 372 double-truck motors, of which 178 are accumulator cars, and 825 single-truck motors, of which 77 are accumulator cars. The two-motor equipment is unformly adopted. Some interesting statistics upon the operation and capacity of this line are presented.

Among the Swiss roads there are many interesting installations, and because of the peculiar conditions under which these systems are operated many important modifications have been introduced. The electric roads in France represent about 25 per cent. of all the tramways of France, and include the overhead trolley, conduit and contact button and accumulator systems, the last three being in more extended use in France than in any other European country. In no other country of Europe have so many obstacles been placed in the way of the trolley as in France, on the ground that the municipalities desired to preserve the beauty of the streets and to assure safety. Some interesting statistics are presented upon the amount of traffic handled by the several companies, especially those of Paris. It is mentioned that the tramways of Paris represent probably the greatest variety in design and equipment to tbe found in any city in the world. The multiple unit system seems to be particularly favored by the leading Franch engineers. The development of the electric railway in Holland has not kept pace with that of Germany, Switzerland and France, and many important points are entirely without electric service, even Rotterdam, the celebrated seaport, having no electric railway whatever. The articles of which this forms the opening installment, are simply technical descriptions of continental European practice of to-day and an explanation of the conditions under which these railways have been installed and operated. Another article in this series is promised for an early date.—*St. R'y Jour.*, June 7, and *Int. Ed.*, June.

Causes and Remedies for Vibration.—MALLOCK.—A paper forming part of the report of a committee appointed by the Board of Trade, to conduct experiments on the Central London Railway. The writer explains the effect of irregularities in the road construction and defects in wheels in causing vibrations. An analysis of the experiments showed that it was a matter of chance whether a locomotive caused a slight or severe vibration. It is concluded that objectionable vibrations can be avoided by reducing the non-spring borne load on each axle to something under two tons in the case of a train running at speeds up to 30 miles an hour, and on rails laid in any of the usual ways. By the use of rolling stock in which only a small load is constrained to follow the surface of the rail, general security is attained, and the permissible non-spring borne load is quite sufficient to allow for proper strength and dimensions in the wheels, axles and other parts of which it is made up.—*St. R'y Jour.*, May 17, and *Int. Ed.*, June.

Selection of Street Railway Motor Equipment.—JONES.—A paper read before the convention of the Southwestern Gas, Electric and Street Railway Association, at San Antonio, Texas. He starts out with a statement that 50 per cent. of the electric roads of the United States are consuming at least 40 per cent. more power than is necessary to operate their cars and make their schedules; another 25 per cent. are consuming 20 per cent. more power than is necessary; 15 per cent. are using 10 per cent. of needless energy, and only 10 per cent. of the systems are operating on the best possible economy. The source of this data, however, is not given. The paper is intended to treat of only one feature of the equipment, that of the car equipment. The author seems to think that if more care and greater discrimination were exercised in the selection of this important element, the showing of the operating companies would be much better. The conditions, however, which he mentions are not those which are met with in ordinary city practice, and the inference may be drawn that he is dealing with almost ideal conditions. These, of course, are not to be found in everyday work.—*St. R'y. Jour.*, May 17.

London County Council Cars.—An illustrated description of details of the London County Council cars. They are double-deck cars of the Preston pattern, with reversed staircase, and seating capacity for 66 passengers, 28 inside and 38 outside. The trucks will be similar to those operated by the Metropolitan Street Railway Company, of New York, with the exception that they will have wrought forged side frames. Series-parallel controllers have been adopted.—*St. R'y Jour.*, May 10.

REFERENCES.

Railroad Track Tools.—An illustrated description of a roller rail-bender, a drill to hook under the track, a Union track drill and a "Jenne" track jack.—*St. R'y Jour., Int. Ed.*, June.

A Novel Electric Switching Locomotive.—A description of a locomotive, used for handling cars from the tracks of the N. Y., N. H. & H. R. R. R. Co., which connects with the yard tracks of the large manufacturing companies. It is equipped with air brakes, and has a snow plough at each end, and the wheels are in addition protected by diggers and scrapers.—*St. R'y Jour.*, June 7, and *Int. Ed.*, June.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

REFERENCE.

Manchester.—A well illustrated description of the recently completed extensions of the Manchester municipal electric plant. The system adopted is three-phase alternating currents of a frequency of 50 cycles per second, generated at an extra high pressure of 6,500 volts, and transmitted at this pressure to the substations. The supply from the substations is at 500 to 550 volts pressure for supply to the tramways, and at 410 to 205 volts pressure for lighting and power purposes.—Lond. *Elec.*, June 6.

WIRES, WIRING AND CONDUITS.

Roof Insulation of 15,000-volt Lines.—An illustrated description of a novel method, devised by Beck, for taking high-tension line wires into and out of station buildings. It has been used with perfect success in the Los Angeles substation of the San Gabriel Electric Company, in California, and is now being adopted in all the high-tension distribution work of the company. The pressures insulated by this device range from 2,400 to 15,000 volts. The conductor, which is always of No. 6 B. & S. gauge, is encased in 15,000 volt, solid rubber hoss. Then this is encased in a good quality of three-quarter inch garden hose, the whole being threaded through a special inside porcelain bushing, having a length of 18 inches, an outside and an inside diameter of 1.75 and 1.25 inches, respectively. Next, this bushing is sulphur-cemented into a special white porcelain bushing measuring 8 inches in length by 2.25 inches inside diameter, by 3 inches in outside diameter. The cap is then knocked off a glass insulator (No. 1 Provo type), and the heavily insulated conductor is passed up through it, after which it is carefully taped and P. & B. painted, especially at the point of passing through the insulator top and at the ends of the special insulation of white rubber and selected garden hose, make a sung fit, one over the other. The outside diameter of the three-quarter inch rubber hose must be larger than the pin clearance of insulator, so that the insulator has to be screwed down over the hose until the 18-inch bushing enters the inner petticoat of the insulator, when the two are sulphured together by pouring sulphur into the inner petticoat of the insulator and around the top of the 18-inch porcelain bushing, making the whole one rigid piece. After being placed vertically in a board having the pitch of the roof, it is then ready for use, and, it is said, that it may be relied upon as being both moisture-proof and puncture-proof.—*Jour. of Elec.,* May.

ELECTRO-PHYSICS AND MAGNETISM.

Conductivity Produced in Gases by the Aid of Ultra-Violet Light.—TOWNSEND.—An account of experiments made to test the theory of the genesis of ions by collision. The conductivity of a gas was started by means of ultraviolet light. The conductivity was measured between two parallel plates at different distances apart. The light fell on the negative electrode, which was a zinc plate; it has the effect of setting free negative ions from the surface of the zinc plate. These ions, as they move through the gas under an electric force, produce others by collisions with molecules. The increase of conductivity obtained by separating the plates is thus explained. The exeperiments also lead to the conclusion that the ions generated in the gas have exactly the same properties as the ions set free from the zinc plate. He made experiments with air, hydrogen and carbonic acid. The results are given in tables and diagrams. They lead to the conclusion that the negative ions generated in a gas by the motion of the zinc ions set free by ultraviolet light are identical with the ions produced by Röntgen rays in the same gas. These negative ions are small compared with the molecules of any of the gases; the molecule of a gas makes more than four times the number of collisions which a negative ion makes in going through the same distance of the gas at a given pressure; also, the property which they possess of generating new ions does not belong to the positive ions under similar conditions of force and pressure. It is possible to detach a particle from the molecule of a gas which is small, as regards mass and linear dimensions compared with the molecule of hydrogen; the particles produced from molecules of different gases are also identically the same. A considerable number of phenomena connected with the electric discharge in gases may be explained in a general way by taking into consideration the physical properties of these negative ions. Thus some of the effects of variation of pressure, electric force, and distance between the plates can be accounted for. The high conductivity of gases under rapidly alternating forces may also be due to the fact that the negative ions traverse a long distance before they are discharged by the electrodes. There are, however, many phenomena for which these physical properties supply no explanation, such as the appearance, at the electrodes, of the constituents of compound gases.—*Phil. Mag.,* June.

Theory of Electrons.—FLEMING.—Some editorial notes on his recent discourse before the Royal Institute. He assumes J. J. Thomson's hypothesis, which imagines an atom as consisting of a nucleus clothed by negative electrons. Thus an atom, less an electron, is positive, and may be called a positive ion. The electrons diffuse through matter by threading about between the atoms or molecules, while these are vibrating with that motion which we call heat. When a metal is cooled the electrons pass about more freely than before, or, in other words, the electrical conductivity is now greater. If two different substances be placed in contact, diffusion of electrons takes place across the junction with unequal rates in opposite directions; and this process will continue till an electronic pressure is set up, which tends to equalize the rates of diffusion; thus, Volta's contact electricity is explained. If a piece of copper and a piece of zinc be touched together and then dipped in acidulated water, a flow of positive hydrogen ions starts towards the copper to unite with its surplus of electrons, and thus, if the plates be joined to make a voltaic cell, a continual diffusion of electrons takes place round the circuit; the old question as to the whereabouts of the seat of the e. m. f. is thus answered; it is equally distributed in all parts of the circuit. Editorially it is remarked that if the electric resistance of a conductor is due to the clogging action of the moving atoms, there must be a time-lag between the change of resistance and the change of local temperature in any small volume-element of the conductor—Lond. *Elec.,* June 6.

Electrons.—MACKENZIE.—A Franklin Institute paper on "the question of the divisibility of the atom." He first gives a concise review of the various experimental researches which have led to the modern hypothesis of electrons cathode rays, Leonard rays, Becquerol rays, etc., and the Zeman phenomenon. He outlines the different methods by which J. J. Thomson has calculated the relation of the mass of electric charge of an electron and both these quantities separately. The mass in grams of a negative corpuscle or electron in a gas at low pressure is about 3 divided by the 26th power of 10. It is found not only in low pressure vacuum tubes, but is given off by incandescent metals, by metals illuminated by ultraviolet light, and by radio-active substances; and in every case it has the same mass and the same charge, and a velocity which is a large fraction of that of light, the radium corpuscles having the greatest velocity, namely, two-thirds that of light. He freely discusses the bearing of this hypothesis on the structure of matter: "If mass is our criterion, we have in the electron a sub-atom, and since it is the same for all elements, we have by inference the ordinary 70-odd atoms as aggregations of this sub-atom."—*Jour. Frank. Inst.,* June.

Repulsive Forces in the Universe.—DESLANDRES.—A paper in which he calls attention to the astronomical importance of the Maxwell-Bartoli pressure of radiation in the evolution of celestial bodies. Arrhennis' theory of the aurora and of comets may be reduced to the single hypothesis of the projection of cathode rays from the sun. All celestial bodies share a continuity of transition from one type to another. Most nebulæ show evidences of a spiral structure with two spirals diametrically opposed. Any great protuberance of the sun is accompanied by a similar protuberance at its antipodes. The only difference between the sun and the nebula is that in the latter the repulsive force is strong, while in the solar type the attractive force is the strongest. There may be a periodic oscillation from one type to another. He points out that a sudden increase in the light of a comet should take place whenever it is exposed to the rays from a large protuberance or facula.—*Comptes Rendus,* May 20; abstracted in Lond. *Elec.,* June 6.

Production of a Magnetic Field by a Flight of Charged Particles.—WOOD.—A brief communication, giving a preliminary account of experiments made by him and Pender. In the various modifications of Rowland's experiments on electric convections, centrifugal force places an upper limit to the attainable velocity of the moving charge. If the revolving disk is abandoned and a flight of charged particles substituted for it, much higher velocities can be obtained. By driving a cloud of charged particles of solid carbon dioxide through a long glass tube placed under a magnetic needle, a deflection of the needle has been obtained. Reversing the direction of the jet invariably reverses the direction of the deflection.—*Phil. Mag.,* June.

Thermoelectric Hysteresis.—PINEZOWER.—A description of what appeared to him a well defined case of thermoelectric hysteresis; he observed that the thermo e. m. f. between two metals differs accordingly as to whether the temperature of the hot junction is attained by heating, or by cooling from a higher temperature. The theoretical importance of such a hysteresis has led the present author to repeat the experiment with an apparatus of greater accuracy and sensitiveness than Bachmetieff's. The result was negative. A great variety of metallic combinations were chosen, and a wide range of temperature. The e. m. f. was measured by a zero method. The

standard "hot" temperature was that of boiling water, and this was reached either by exposure to steam or by cooling from the temperature of a Bunsen flame, or an oil bath. The e. m. f. was always found to be that corresponding to the interval of temperature, no matter how the temperatures were reached.—*Mitt. Phys. Ges., Zuerich,* No. 1, 1901; abstracted in Lond. *Elec.,* June 6.

Change of the Resistance of Metals when Placed in a Magnetic Field.—PATTERSON.—An account of a series of experiments on some of the non-magnetic metals, to see whether they show a change of resistance in a transverse magnetic field. His results show that such a change exists in the case of copper, cadmium, zinc, gold, platinum, tin, silver, carbon. According to J. J. Thomson, this phenomenon is explained by the corpuscular theory of electric conduction in metals; the electric currents in metals are carried by negatively charged corpuscles moving with a definite velocity under an applied e. m. f.; these corpuscles are considered to act as a perfect gas; consequently they have a mean free path and mean velocity and exert a definite pressure. If the corpuscles are moving under an electric force and then a transverse magnetic force be applied, the particles move in cycloids; their path is thus increased, and consequently the resistance of the conductor is changed. The present author applies this theory to a numerical calculation of his experiments. For platinum he finds that the number of corpuscles in 1 cc. is 1.4 multiplied by the 22d power of 10, and the pressure exerted by the corpuscles is about 700 atmospheres. He also calculates, from the corpuscular theory, the contact-difference of potential of two metals in contact: it is in volts, Cu, Pt 0.0239; Cu, An 0.0177; Cu, Az — 0.0015, etc.—*Phil. Mag.,* June.

Sensitiveness of the Coherer.—WOLCOTT.—An account of experiments made to determine quantitatively the effect of electromagnetic radiation upon coherers composed of metals of various critical potentials, including aluminum, tin, iron, zinc, lead, nickel, copper and silver. He finds that the "electrolytic" theory of Guthe and Trowbridge corresponds most closely with the facts. According to this theory the potential gradient across the coherer causes an attraction of the electrodes to within molecular distances, thus making a continuous bridge. Of all the metals tried, aluminum is the most regular in response. It has been found, however, by Marconi and others, that nickel gives the best results at long distances. This is probably due to the fact that of all metals tried, the surface coating of nickel shows the lowest critical potential, that is, it responds to the least energy; but when the intensity of the radiation is sufficient to overcome the greater critical potential of aluminum, the latter gives better results than nickel, for the regulating of response has been shown to depend upon the metal itself. Accordingly, it appears that the best results would be obtained by using the metal which shows the greatest regularity of response, coated with a medium which gives the lowest critical potential.—*Bull. Wisc. Univ.,* No. 51, 1901; abstracted in Lond. *Elec.,* June 6.

REFERENCES.

Waves.—POLLOCK AND VONWILLER.—An acount of some experiments on electric waves in a short-wire system. Observations were made of the waves along free wires, and also of the vibrations in the two systems formed when the wires are bridged at various points. A sensitive method for finding the specific inductive capacity of solid dielectrics with Hertzian waves, is also described.—*Phil. Mag.,* June.

Coefficient of Mutual Induction.—SEARLE.—A mathematical paper. Maxwell calculated the coefficient of mutual induction of two circular circuits, whose axes meet in a point at any angle. The present author calculates by an analogous method the coefficient of mutual induction when one of Maxwell's circles is replaced by a circuit having two infinitely long parallel sides, the shortest distance between the sides being finite. A telephone circuit with its pair of parallel wires is a practical approximation to such a circuit.—*Proc. Cambridge Phil. Soc.,* May 11; briefly abstracted in Lond. *Elec.,* June 6.

ELECTRO-CHEMISTRY AND BATTERIES.

Influence of Temperature on the Capacity of Accumulators.—HIBBERT.—An article in which he first refers to the papers of Schoop, Heim and Liagre (all of which have been abstracted in the Digest), who had found that a rise in temperature causes a marked increase in the ampere-hour capacity. He points out that this is in close connection with the concentration changes in the electrolyte; at higher temperature diffusion acts more quickly; it can more quickly replenish the acid consumed in the pores of the plates during discharge and so keep up the e. m. f. Similarly, during charge, strong acid can more quickly diffuse out of the pores of the plates, and the e. m. f. never rises so high. At ordinary temperatures the diffusion rate during discharge is too slow to keep up the acid strength when about half or one-third of the active material has been changed to sulphate, owing to the partial clogging of the pores. But at higher temperatures the diffusion rate is able to keep up a sufficient acid strength in the pores till a much greater degree of clogging has occurred. He then discusses whether it would be advisable to use a higher temperature in battery rooms in practice. Heim has stated that the Hagen Company does not recommend this, as their experience is that accumulators which happen to work in warm stations are injured by the high temperature. Reference is made to an old paper by Gladstone and the writer, in which they said that while the capacity can be increased 40 or 50 per cent. by warming, yet "the increased temperature would increase local action, and the (direct) chemical action of the acid upon the spongy lead." Yet there is a possibility of getting some of the advantage due to higher temperature, as the increased action on both plates might be counteracted by a reduction in the strength of the acid. Each battery manufacturer should determine for his own type of cells at what temperature and with what strength the advantage is a maximum. "Till this and similar work has been done, the making and using of accumulators will stand on a different basis from that employed in the design of dynamos and engines."—Lond. *Elec. Rev.,* May 30.

UNITS, MEASUREMENTS AND INSTRUMENTS.

British National Physical Laboratory.—CAMPBELL.—A description of the electrical equipment of this new laboratory. A supply of current is obtained from a steam turbine-driven 60-kw dynamo, a gas engine driven smaller dynamo and a motor-generator; there are also three storage batteries, one being reserved exclusively for electric heating in the thermometric department. Arrangemnts for supply of altrnating current at various frequencies are under consideration. There are three rooms devoted to purely electrical work; one is adapted for preserving constant temperature, it contains among other apparatus the Brit. Ass. standards of resistance and a Carey-Foster bridge for comparing resistances to a high degree of accuracy; the other two electrical rooms contain the primary and secondary standards, respectively, also the instruments devoted to capacity and inductance work, the latter including the magnetic testing of iron. There are two large air condensers, consisting of a large number of concentric brass cylinders supported in such a way that the alternate ones are insulated from the others, the dielectric substance being dry air; the capacity of each is about 0.02 microfarad. These condensers are said to be very trustworthy and convenient. Their absolute values have recently been redetermined by the following method: The condenser, with a suitable commutator, is made, one of the arms of a Wheatstone bridge, and the commutator is rotated at a uniform speed in such a way as to charge and discharge the condenser. The condenser arm of the bridge thus transmits a pulsating current and becomes equivalent to a resistance. If the moving part of the galvanometer has a sufficiently slow time of swing, a balance can be obtained in the ordinary way, and the capacity of the condenser calculated from the values of the resistances and the frequency of commutation. The speed of the commutator is regulated by the aid of a stroboscopic disc, which is viewed through the slits carried by an electrically-driven tuning fork, friction being applied by a cord to a pulley on the disc so as to keep the image, seen through the slits, steady. By means of Kelvin's method, commercial capacities are compared with the air standards. From the standard capacity can be obtained a standard inductance, or a standard of magnetic flux. There is also a Ewing permeability bridge of the latest pattern, with the additional apparatus necessary for the calibration of the standard bars. Commercial testing of transformer sheet has already been taken in hand. It is hoped that before long facilities will be available for testing incandescent lamps for candle-power, efficiency and life; the photometric standards at present used in Great Britain by different people vary very widely from one another, variations of 10 to 15 per cent. being not uncommon. The thermometric department has been equipped; resistance thermometers, thermojunctions and other pyrometers are tested up to 1,300 and 1,400 deg. C. For obtaining the necessary steady high temperature, two electric ovens have been set up. The electric equipment of the laboratory is only

in progress; before long there will be set up apparatus for supplying high voltages and for testing insulation resistance.—Lond. *Elec. Rev.*, June 6.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Telephone Cables.—J. H. WEST.—An illustrated description of a telephone cable, devised by him for the purpose of getting a low capacity and a high self-inductance. For this purpose it is necessary to make the distance between the two wires of a twin conductor as large as possible, and to use for insulation as much air as possible and as little paper or other solid dielectric as possible. He insulates two or four wires from another by means of a slotted strip of cardboard; this strip being wound in a spiral form, and the wires being placed in the slots. Several constructions of this form are shown diagrammatically; one construction for a two-wire conductor is shown in the adjoining Fig. 1, the cross-section in Fig. 2, the strip

FIGS. 1 AND 2.—TELEPHONE CABLE.

of cardboard in Fig. 3; *a* are the wires, *s* the teeth of the cardboard, and the lines *cc* and *dd* are indentures at which the cardboard is bent. He gives the results of measurements made by the Reichsan-

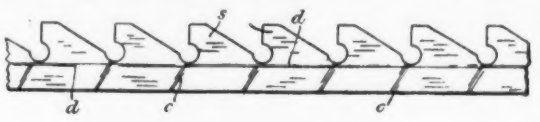


FIG. 3.—TELEPHONE CABLE.

stalt with a cable consisting of seven bundles, each of four wires, of which the bundles Nos. 1, 3, and 5 have wires of 1.5 mm., and bundles Nos. 2, 4. 6, 7 wires of 2 mm.; the capacity of a wire per km. in microfarad for bundles 2 to 7 is in microfarads 0.039, 0.033, 0.037, 0.032, 0.039, 0.037; the capacity of a loop per km. in microfarads for bundles 2 to 7 is 0.020, 0.017, 0.019, 0.017, 0.020, 0.020; the inductance of a loop per km in henrys for bundles 1 to 7 is 0.00108, 0.00100, 0.00106, 0.00113, 0.00109, 0.00101, 0.00101. The process of manufacturing is said to be very simple.—*Elek. Zeit.*, May 15.

New Books.

HIGH SCHOOL PHYSICS. By Henry S. Carhart, LL.D., and Horatio N. Chute, M.S. Boston: Allyn and Bacon. 433 pages, 322 illustrations.

The authors of the above work have succeded in writing a book which should be classed among the relatively few standard text-books. It is divided into the following principal divisions: Mechanics, Sound, Light, Heat and Electricity and Magnetism. "The authors hold firmly to the opinion that the class room and the laboratory should be provided with separate books." This class-room book is thoroughly up-to-date in point of view and treatment of the material; and the large experience of both of the authors in teaching physics, one in the university, and the other in the high school, has guided them to a discriminating choice as to the matter to be included, for it is quite out of the question to attempt to make any text-book encyclopedic in characer. There are many figures illustrating the text, and the problems at the close of the chapters are well chosen. The workmanship of the book is excellent.

THE BALANCING OF ENGINES. By W. E. Dalby, M. A., B. Sc. New York: Longmans, Green & Company. 283 pages, 173 illustrations. Price, $3.75.

A few years ago the literature relating to the subject matter of this book consisted of an occasional paper to be found in the transactions of engineering societies. Since then this subject has forced itself upon the engineers to such an extent that at several recent annual meetings of engineering societies papers relating to it have far outnumbered those relating to any other one topic. During the past few years there has thus grown up a very extended literature of this subject and it has become of such importance as to justify an author of judgment and experience in preparing the present work devoted solely to this topic.

The book is divided into eight chapters of which the first relates simply to a discussion of the subject of "Vector Quantities." In the remaining chapters of the book the details of the subject are developed in a simple manner and yet sufficiently general in treatment to cover all practical requirements of the engineer. The problem of the balancing of a revolving mass is first treated, then follows the reciprocating mass with the infinite connecting rod, and then the reciprocating mass with the influence due to the angularity of a finite connecting rod. A special chapter is given to the subject of vibration of supports and of the frame work of the engine, at the same time including the question of turning effort and its uniformity.

The book is intended to be essentially practical in character and to give for the investigation of problems in balancing and for the computation of the forces developed, a semi-graphical method, which has proved itself suitable for the investigation of such problems in drawing office practice. The style of the author is simple and clear, and the illustrations are especially noteworthy for their clearness and simplicity, having in view the character of the questions under consideration. The book may be cordially recommended to all who are concerned with problems of this character.

AN ELEMENTARY TREATISE ON ALTERNATING CURRENTS. By W. G. Rhodes, M. Sc. London: Longmans, Green & Company. 211 pages, 83 illustrations. Price, $2.60.

In his preface the author announces that he has aimed to present his subject without that indulgence in mathematical gymnastics to which many of his colleagues have been prone. This intent is doubtless most commendable, but the reviewer cannot unreservedly congratulate Mr. Rhodes on the results; for, while it is true that this volume is not wholly a wilderness of figures and formulæ, brevity has frequently been attained by simply omitting intermediate steps in a development, which is hardly desirable in an elementary text-book. On the other hand, it cannot be denied that the arrangement of subject matter is most excellent and that the author's clean-cut and forcible English illuminates many an obscure path for the student. The practice so common abroad of emphasizing paragraph headings and important conclusions by using heavy type has been followed here, and while this is regarded with disfavor in many quarters in this country, it certainly enhances very materially the value of a book as a reference volume and must assist those readers who are taking up the subject for the first time.

Another excellent feature is the insertion of a brief chapter on the elements of vector algebra. The author states his belief that one should form a part of any volume on this subject and that vectors should be used as much as possible in solving problems, with both of which points we heartily concur.

The chapters on kicking coils, transformers and alternating-current machinery are, while of course elementary, good. That on the measurement of power in alternating-current circuits is very meagre and disappointing. No effort has been made to point out the almost prohibitive drawbacks of the antiquated three-voltmeter and three-ammeter methods, which have been dragged in, and they receive relatively the same amount of attention as the employment of a true watt-meter instead of being relegated to the limbo of the forgotten and impracticable that they deserve.

The presswork, paper and binding are all good and there are remarkably few typographical errors, even if the author is made to say at one point that "the practical unit of capacity is a Farad."

GRUNDRISS DER ELEKTROTECHNIK. Von Heinrich Kratzert. II thiel, 2, 3, 4 and 5 buch. Leipzig und Wein: Franz Deuticke. 436, 275, 208, 75 pages. Prices, respectively, 10, 6, 6 and 3 marks.

This is one of the best text-books of electrical engineering in the German language. It is essentially an engineering text-book, written by an engineer for engineers. The style is simple and clear, the illustrations numerous and well chosen, the diagrams in particular being admirable for their simplicity and directness.

Part 2 relates to electric lighting, with 436 pages and 439 illustrations, averaging over one illustration per page of text. The description is excellent and modern. It is curious to observe that in Austria the standard of light seems to ba a "Munich Stearine Candle," burning 10.4 grammes per minute. Part 3 is devoted to power-transmission, electric railroads, electric automobiles, the costs of electric apparatus and the specifications for safe installation published by the Association of German Electrotechnists. It contains 275 pages and 149 illustrations.

Part 4 relates to electrochemistry and deals with primary anl secondary batteries, electroplating, electrometallurgy, and short chapters on electrolytic products. 208 pages, 94 illustrations.

Part 5 treats of electric machinery in mines, farms, and on board ship. The description of electric mining and farming apparatus is the most complete we have seen in the German language. 75 pages and 44 illustrations.

Taken collectively the book is of great value to the electrical engineer, as representing Austrian and German practice in various directions, but particularly in electric lighting.

Das Elektrotechnische Institut Zu Carlsruhe. By Prof E. Arnold. Berlin: Julius Springer. 60 pages, 29 illustrations.

This is an elaborate pamphlet describing the equipment of the technical college above mentioned. The power plant is a 22-kw unit, comprising a gas engine, to one end of whose shaft is direct-coupled a direct-current generator, and to the other a polyphase machine. The capacity of the engine is such that only one of the two generators may be loaded up to its full capacity at any one time, but there is an elaborate equipment of storage batteries so that both high-tension low current and low-tension heavy direct-current experiments may be carried on while the alternator is being used for other purposes.

A 7-kw direct-current unit, also driven by a gas engine, is installed in the machine shop, and like the larger one has its dynamo provided with a permanently attached set of exploring brushes, so that the distribution of potential around the commutator may be plotted The distribution of current through the building is on the elaborate scale usual in such cases. Liberal use is made of gridiron interconnecting boards of the type employed in telegraph offices in this country, so that almost any variety of current may be plugged into a given line.

All wiring is exposed and on porcelain knobs, the conductors being transposed between each pair of adjacent knobs to avoid magnetic disturbances in the numerous testing rooms. The collection of measuring apparatus seems small but well selected. A very good photogravure of the building itself serves as a title page, and line drawings reduced from the architects' plans show the interior arrangements, the best feature of which is, perhaps, the large square inner court affording good illumination for all of the rooms.

BOOKS RECEIVED.

Dictionnaire Electrotechnique. French-German-English. By Paul Blaschke. Leipzig: S. Hirzel. 144 pages. Price, 5 marks.

Congré International D'Électr cité, Paris, 1900. Rapports et Procés-Verbaux. By E. Hospitalier. Paris: Gauthier-Villars. 525 pages, illustrated. Price, 20 francs.

Directory of Electrical Societies, Etc.

American Association for the Advancement of Science. Next meeting, Pittsburg, June 28 to July 3, 1902.

American Electochemical Society. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Edison Illuminating Companies. Next meeting, September, 1902.

Canadian Electrical Association. Next meeting, Toronto, Ont., 1903.

Electrical Contractor's Association of New York. Semi-Annual meeting, Hotel Ten Eyck, Albany, N. Y., July 15, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electrical Contractors' Association. Annual meeting, Hotel Walton, Philadelphia, July 16, 1902.

National Electric Light Association. Next meeting, Chicago, May, 1903.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Old-Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Salt Lake City, Utah, September, 1902.

Society for Promotion of Engineering Education. Next meeting, Pittsburg, June 28 to July 3, 1902.

The American Electro-Therapeutic Association. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

Multiple Arc Lighting System.

The Fort Wayne Electric Works has developed a street lighting system, the leading feature of which is the readiness whereby existing incandescent lighting systems by its use may be adapted to include an arc lighting system with a minimum expenditure for line material and equipment. The general plan of this multiple system of enclosed alternating arc street lighting is illustrated in Fig. 1. This diagram shows a complete installation, and illustrates the method of distribution by a three-wire system from which incandescent lights and arc lights may be operated from the same high potential mains. The particular application here illustrated is that of 2000-volt alternating-current incandescent

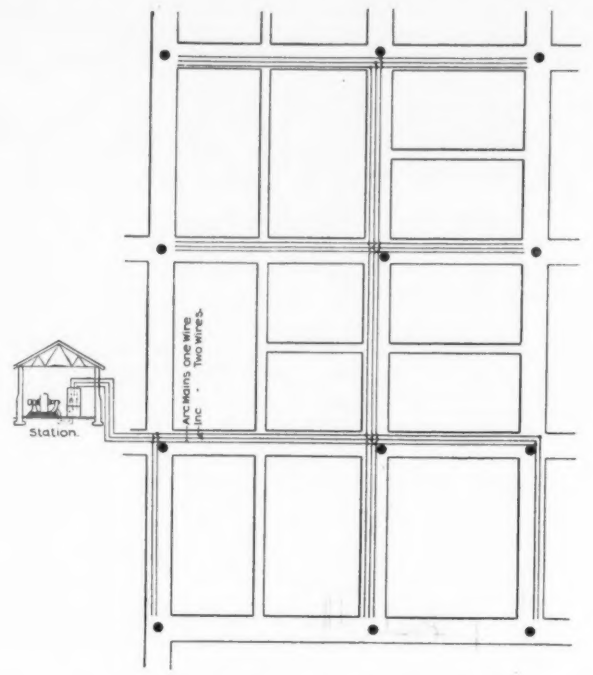


FIG. 1.—MULTIPLE ARC LIGHTING SYSTEM.

distribution system, having step-down transformers from which the secondary mains are supplied with current at standard incandescent lamp voltages.

Fig. 2 illustrates the only change in the equipment of the power station rendered necessary by the addition of such an arc lighting distribution system. By referring to same, it will be noticed that it has been necessary only to install one wire in addition to the incandescent mains, and a single pole, single throw switch, *A*, connecting this third wire with one side of the incandescent lighting circuit. The arc lamps are operated on small individual constant-current transformers—one transformer for each lamp—connected to the third wire and the opposite side of the incandescent circuit. By this means it is possible to use one side of the existing incandescent lighting circuit as a common wire for the arc lighting and incandescent lighting circuits. This plan can be followed in a great majority of cases. There are, however, a few instances where incandescent mains and arc circuits are widely separated, and it is here found necessary to extend one side of the incandescent mains to accommodate the arc lighting circuit.

In general, this system can be installed in any locality requiring street lighting, but the particular case where its application can be made most advantageously, is in small towns or suburban districts already supplied with an incandescent lighting system. In such cases the demand for light is not usually such as to warrant an outlay of capital sufficient to provide a separate set of arc light mains and the accompanying switchboard and other station

equipments. The usefulness and adaptability of the system is not limited to the cases just mentioned, but it may be extended to the full capacity of the station. In this way a much larger generating unit may be installed than is needed for incandescent lighting, thus obtaining the advantage of high efficiency generator, as well as saving in the original cost of installation.

The "Wood" transformer, used with this system, is designed to operate on 1000 or 2000-volt primary alternating current circuits, and develops practically constant energy in the secondary with wide variations of resistance in the secondary circuit. A short circuit of the secondary of one of these transformers affects only the one lamp to which it is connected and will not interfere with the operation of any other part of the system. The transformer can be adjusted for various secondary voltages and frequencies. Considerable variation in the primary voltage does not materially affect the value of the secondary current. The primary and secondary coils are wound entirely separate and never come in contact with each other when the various adjustments are made, thus reducing to a minimum the chances of cross connections between the coils. The "Wood"

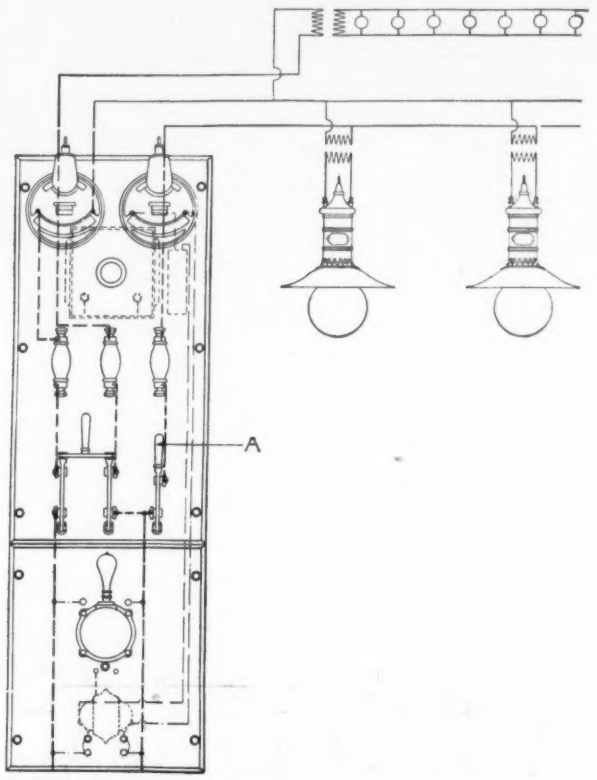


FIG. 2.—MULTIPLE ARC LIGHTING SYSTEM.

primary fuse box used with this system may be either double or single pole, according to the condition of installation.

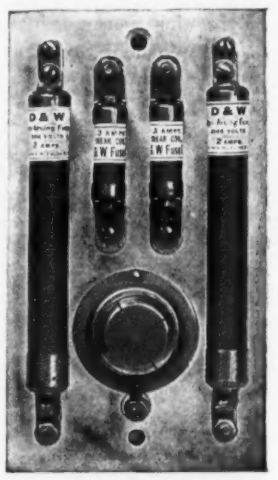
The "Wood" arc lamp used in connection with this system is a new enclosed form, recently developed by the Fort Wayne Electric Works and the general appearance resembles the enclosed series arc lamp, recently introduced. The interior construction and mechanism is practically the same as in the other lamps of this design and includes many of the valuable features of simplicity, interchangeability, cool operation and substantial construction. The lamp operates at 6.5 amperes with 75 volts at the arc and consumes 418 watts.

It is claimed that the efficiency of this system is very high and does not vary with the number of lamps in service, but remains constant for all loads—an advantage possessed by the multiple system which is lacking in other systems in which the efficiency diminishes rapidly as the load decreases. The same may be said of the power factor, which is high and the same with any number of lamps in operation; the system thus does not consume unnecessary generator capacity when operating at light loads. In a constant current system the apparent energy is the same for all loads, which means the same consumption of generator capacity whatever the number of lamps in operation, while in the multiple system it varies in direct proportion to the number of lamps in operation.

The great flexibility of this system is one of its leading features, since it permits the operation of arc lamps of various candlepower on the same circuit simply by the use of properly adjusted transformers. In a series system this cannot be done, as the line current is maintained at a constant value. In many instances it may be desirable to locate single arc lamps where arc circuits are not installed, particularly where municipalities require additional arc lamps at distant points or suburban districts. In such cases it is only necessary to obtain a single unit, consisting of arc lamp, transformer, and fuse boxes, connecting with the primary distribution mains in the same manner as extensions of the incandescent system are made. In this way the system obtains all the advantages of an incandescent lighting system and at the same time retains the valuable features of a multiple arc lighting system. Some of the more important points claimed for this system are its high efficiency and its extreme simplicity and flexibility.

Protectors for Telephone Circuits.

The desirability of "protection that will protect," in the matter of safeguarding telephone circuits and instruments against lightning, etc., is too well known to require much discussion, and, happily, telephone men have long since been aroused to a keen appreciation of securing as perfect appliances for this purpose as can be found. A protector for such use, exhibited at the Independent Telephone Convention, and which attracted much attention, while receiving favorable comment from managers and manufacturers who had used it, was the protector made specially for this class of work by the D. & W. Fuse Company, of Providence, R. I. Their "Combination Cut-out," for such it must be called, embodies the functions and elements of a high tension fuse, a sneak coil and a lightning arrester, and the type herewith illustrated is the complete double-pole form, but without the cap removed from the arrester. The high-tension fuse is connected with the sneak coil, the fuses being outside and the sneak coil inside, above the arrester; these being in series, and the two shunted to earth through the carbon plate of the arrester, which is normally open. The fuse will take care of any current up to a short circuit at 3,000 volts, and, of course, is free from any arc or flash. The little sneak coils operate on from one-tenth ampere up to half an ampere, and the two-tenth ampere form usually recommended for telephone work operates on three-tenth ampere is less than 15 seconds.



PROTECTORS.

The lightning arrester part of this interesting apparatus consists of a carbon block separated from a ground plate by mica, or by an insulating waterproof film, an air-gap of .008 inch being provided with the mica, while .0025 inch with the film form separates the carbon from the ground plate. The entire arrester is enclosed in a metallic casing, which prevents the accumulation of dust, which has frequently been known to cause trouble, and also guards against any risk from the ignition of lint or flying particles during the instant when a discharge occurs across the plates. It is believed by the makers that the "film" possesses certain advantages over the air-gap, inasmuch as the device is practically continually grounded as far as all static discharges are concerned, although at the same time testing clear for all dynamic currents. It was ascertained that static discharges as low as 180 volts potential would readily pass through the film while at the same time this would successfully withstand over 500 volts dynamic current. Moreover, the film possesses the property of automatically grounding the device when the circuit becomes crossed with a high tension line in such a manner that only a small current could pass to earth. The current, which may be too small to cause the fuse to operate, is yet sufficiently great to cause disturbance and trouble on the line. It is then desirable to have the circuit grounded, and this is accomplished automatically under such circumstances by the rapid carbonization of the film. As soon as the line is cleared the film is easily and quickly replaced. This is considered a decided advantage over the air-gap arrester provided

by a mica separator, since a small discharge might continue across the air-gap for many hours, interfering with the satisfactory operation of the line, which would yet be too small to cause the fuse to operate.

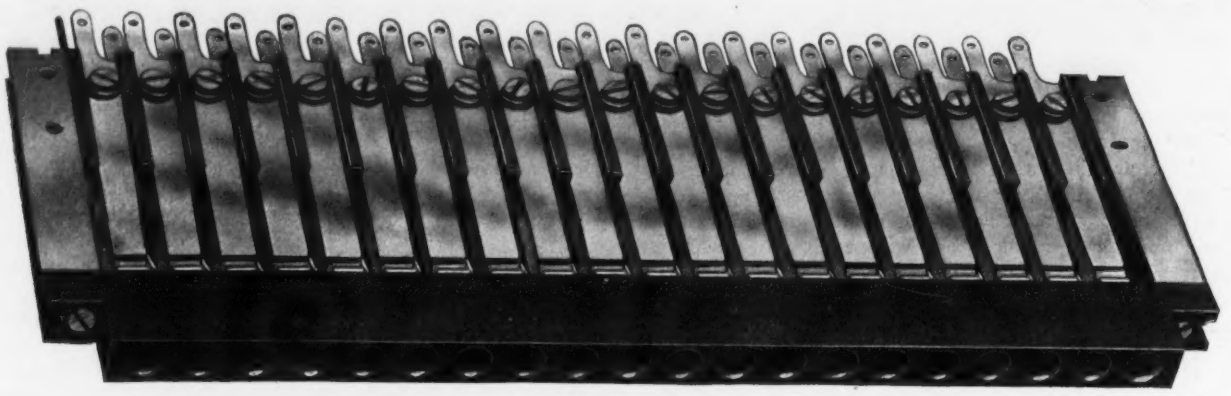
Under ordinary conditions the sneak coil alone would operate where the current was diverted through the instrument, and since trouble from these slight causes is more common than a dead cross, this, an inexpensive and readily renewable device, would alone have to be replaced as the fuse would be unaffectd by its opration. The diverter, or "arrester," only rarely needs attention, and then simply to free it from any carbon particles which may have accumulated within the air-gap where the mica is used, or to renew the films with the other type. The fuse, which is in reality a protector for the device itself, would be called upon to operate only in cases of emergency requiring prompt action without any of the flame or discharge which accompanies every other type of fuse.

A Small Multiple Spring-Jack.

A piece of apparatus, shown for the first time, and one that received a great deal of attention from prominent telephone men at the Interstate Telephone Convention, recently held in Chicago, was a 3-10 in. center multiple spring-jack, built by the Kellogg Switchboard and Supply Company. The accompanying illustration shows this jack, actual size (6¾ ins. long). The jack is known as a two-conductor jack, and is built of the best grade of hard rubber, brass and German silver. There being only one spring in the jack and two contacts in the plug, the 3-10 in. jack can be built substantially and have as high insulation resistance as most jacks on ⅜ in. centers.

This type of jack will be used in the 18,000-line switchboard, which this company is building for the Frontier Telephone Company, Buffalo, N. Y., and also in the 15,000-lin board being built for the Home Telephone Company, Los Angeles, Calif.

An illustration of the amount of work involved in building the multiple jacks alone for a 15,000-line board, may be gained by the following brief facts: The ultimate number of spring-jacks required for a board of this size is 645,000. The ultimate number of strips of multiple jacks is 32,350. The spring-jacks, for the ultimate equipment, placed one on the end of another, would reach 30½ miles.

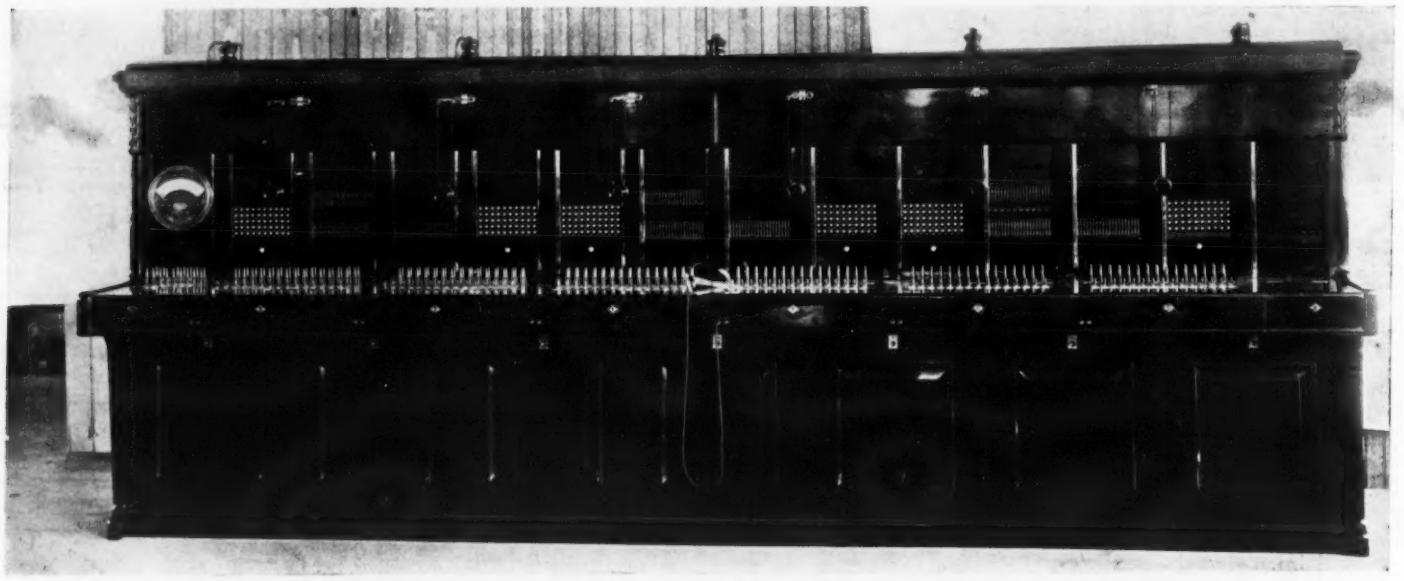


SMALL MULTIPLE SPRING-JACK.

The strips of multiple jacks, placed one on the end of another, would reach 3½ miles. The total number of strips (32,500), even though only 3-10 of an inch thick, piled one on top of the other, would make a column 812½ feet high.

Telephone Service for Manhattan System.

In connection with the many changes and improvements now being made in the Manhattan Railway system, of New York City, the company is installing a new telephone switchboard built by the Lambert Schmidt Telephone Mfg. Company, of New York. This board has a capacity of 500 lines and is complete in every respect. It has six operators' positions and is full multi-

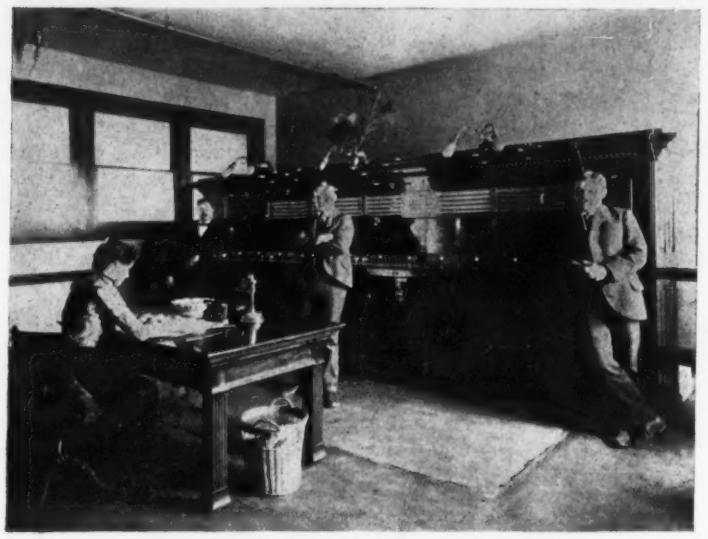


MANHATTAN RAILWAY COMPANY'S TELEPHONE SWITCHBOARD.

to get the maximum amount of speed in view of the fact that a majority of the instruments will practically be used continuously. The telephones will be located at each and all of the stations and offices throughout the system, and many of the instruments will be fully ten miles from "central." This is quite a severe test on a common battery circuit, and in other ways the system will probably be subjected to a more severe test than can come on any equivalent system in the country. It is a private plant doing an excessive duty as a central exchange.

Interior Telephone System for Westinghouse Factories.

Among the many interior systems installed for office and factory work, one of the most complete is that of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. This company purchased and installed some time ago a 500-line Stromberg-Carlson visual signal central energy switchboard, equipped also with sixty trunk lines connecting with branch exchanges located in the Westinghouse Machine Works and the Westinghouse Air Brake Company's factory. The operation of the system has been so successful that a duplicate of the outfit has been



SWITCHBOARD IN WESTINGHOUSE OFFICE.

purchased for the British Westinghouse Electric & Manufacturing Company, of Manchester, England.

These two switchboards are of the multiple type, with multiple jacks grouped in front of each operator up to 600 numbers, and multipled in the same manner in the toll and trunk line operator's position. The power and battery plant is modern and up-to-date in every way. This exchange is remarkable from another standpoint: The operators are called upon to answer 1,500 calls in eight hours. This is only an average record for the service the board is called upon to furnish. While equipped with 15 pairs of connecting cords to each position, with a double supervisory clearing-out system, there are many times during the day when the cords are all in service. This is quite remarkable when one stops to consider that the plant is used exclusively for the local work of the Westinghouse interests, but those interests employ many thousands of men in and around Pittsburg.

Alternating-Current Calculating Device.

Prof. F. G. Baum, of Leland Stanford University, has put in commercial form the alternating-current calculating device which was described in the issue of this journal dated May 18, 1901. The device consists of a series of curves on a piece of cardboard, over which is pivoted a movable piece of mica. The device enables determinations to be simply made of the regulation of a transformer, transmission line or generator, or any combination of these for any load and for any power factor. By its means the following determinations concerning a synchronous motor may also be immediately made:

The excitation to give any desired power factor at any given load; the excitation to give any percentage wattless current at any given load; the current and power factor for any given excitation at any given load; the angular swing of the motor for any given change in load; the maximum load that the motor will lag before falling out of step, and the percentage of compounding that must be given the field of a synchronous motor so that changes in load will not affect the pressure at the terminals.

A 22-page pamphlet accompanies the device, in which its principles are explained and instructions given for its use in making calculations. The calculator may be obtained from Prof. Baum, the cost being $1.00.

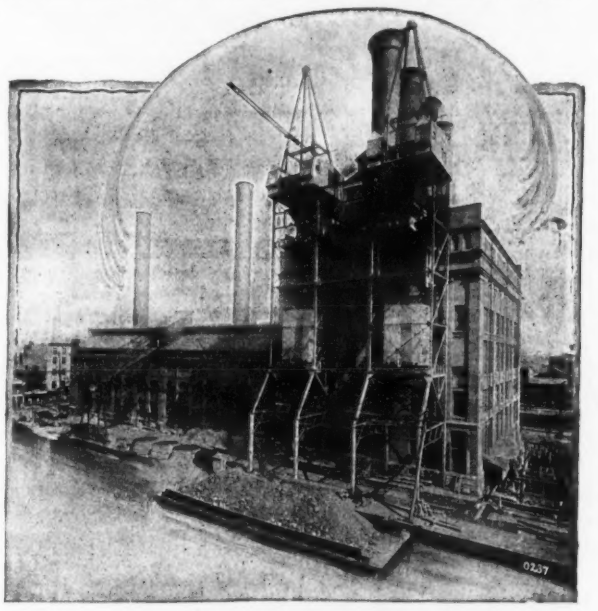
Electrical Equipment for Coal Hoisting Towers in Baltimore.

The great power stations in New York, Baltimore, and other large cities are far from the sources of fuel supply, and each of them consumes as much as a good sized coal mine can produce. The handling of this fuel is a problem of serious moment. It must be done with certainty and celerity, without excessive noise or dirt and at moderate cost. An excellent example of such work can be found in the new central power station of the United Railways & Electric Company, Baltimore.

In the new boiler house now building, thirty-two 500-hp. Babcock & Wilcox water tube boilers are to be located on two floors and in four sections. Four stacks, 200 feet in height and 13 feet inside diameter divide the entire building in two parts, with batteries on either side. Above the boilers are two coal storage bins with a capacity of 6,000 tons. Each bin is 32 feet wide, 34 feet deep and 128 feet long.

The arrangement of the plant necessitates raising the coal to a great height, which together with a large fuel consumption made the conditions most exacting. The coal hoisting towers and machinery were designed and constructed by the C. W. Hunt Co., New York, while the arrangement of the electrical apparatus in the tower is due to P. O. Keilholtz, consulting engineer of the United Railways & Electric Company. On the east side of the boiler house, two steel towers were built for hoisting the coal, one of which has been equipped throughout while work on a duplicate euipment is in progress. This plant has the double distinction of having the highest hoist of any power station and being the only one of its kind equipped throughout with electrically operated hoisting and conveying machinery. Each of the coal hoisting towers is 183 feet high, and the horizontal booms, 52 feet in length, extend over the water. The one-ton shovel is lowered by means of a cable, passing over a truck which runs back and forth on the booms to the shovel below. The shovel hoist and boom truck are driven by electric motors geared to the drums.

From the railway switchboard in the adjoining engine room



COAL HOISTING TOWER.

a 550-volt main extends into the coal hoisting towers. On the first floor of the tower is a motor generator set of standard General Electric type. From this motor shaft the coal crusher is also driven. The purpose of this generator is to supply a suitable voltage current to the hoisting motor on the fourth floor above.

As the turning effort is transmitted through gears to the hoisting drums, it is essential that the gears be not subjected to violent shocks by a sudden application of power. The mechanism is such that the rate acceleration is even, and dependent upon the will of the operator. The hoist motor has ample capacity to operate the shovel. When the shovel descends to the coal in the barge, the hoisting motor is started and closes the shovel, fills

it with coal, hoists it loaded 151 feet over the tower, and dumps the coal into a hopper at the front of the tower on the engine platform. The shovel is then lowered open to the coal and is ready for another trip. An engineer and assistant regulate the operation of the hoisting machinery from the second platform in the tower, the former controlling the hoisting drum motor, and regulating the speed and direction of rotation; the latter controls the motor hoist actuating the trolley on the boom. The shovel does not twist in hoisting or lowering, notwithstanding the great height of the hoist. The coal passes from the hopper through a coal cracker, where the large lumps are broken to the proper size for automatic stokers. By means of a double jawed cut-off valve, the coal is fed into an automatic railway car, then weighed. After the car is pushed off the scales, it passes to an inclined track over the bins, and is automatically discharged by a stop previously located at the point where the coal is needed. The inertia of the loaded car on the incline is stored in a counter-weigher which, when the load is dumped, returns the car to the scale for another load.

The tower was equipped by the C. W. Hunt Company and has a capacity of 50 tons of coal per hour. Recent records show that the hoist will deliver considerably more coal than the capacity given above. While the consumption of coal in a station of this size would probably be 100,000 tons per year, the coal handling plant has a capacity of ten times that quantity of fuel taken from the boat and delivered to the storage bins.

Under each of the boilers is an ash hopper with a cut-off valve. The Hunt noiseless gravity bucket conveyor receives the ashes which descend into, and are removed from, the hoppers by gravity. The ashes are carried over the coal pockets and dumped into a chute leading into ash bins in the tower; from thence they are removed by car or boat. This conveyor is 430 feet long, with a vertical lift of 86 feet and is motor driven. When carrying a load of ashes, it requires but 5 horse-power to keep it moving. No shoveling or manual labor of any kind is required in receiving, transporting or emitting coal or ashes from this plant, and the machinery is as nearly automatic in its operation as possible.

Electric Railway Development in Northern New York State.

The Hudson Valley Railway Company is a consolidation of the Stillwater and Mechanicsville, Greenwich and Schuylerville, Glens Falls, Sandy Hill & Fort Edward, and Warren County Railroads and the Saratoga Traction Company. The Company has now in operation over one hundred miles of electric road running north from Albany and Troy to Saratoga, Lake George and the Adirondacks. At the present time power for operating the road is derived from several independent power stations located at Stillwater, Saratoga, Middle Falls, Glens Falls and Caldwell. Ultimately, power for operating the entire system will be developed on the Hudson River near Waterford.

For the operation of the road until the Hudson River power station is completed, a somewhat unusual and interesting method will be used. The company has increased the capacity of the direct current power station at Glens Falls by installing a 250-kw. direct-current engine-type generator and has increased the capacity of the Caldwell station by installing a 270-kw., direct-current, belted generator. In the power station at Glens Falls there will be installed a 250-kw. rotary converter operating direct current to alternating current with raising transformers. Power will be transmitted by a three-phase, 11,000-volt transmission line to Caldwell, where lowering transformers and a second 250-kw. rotary converter operating alternating to direct current will be installed to supplement the power of the Caldwell direct-current generating plant.

At the company's power station in Saratoga there is to be installed a 400-hp. engine and 250-kw., 2200-volted, belted, alternating current generator with raising transformers. From this power station power will be transmitted by a three-phase, 11,000-volt transmission line to a substation at Round Lake where lowering transformers and a 250-kw. rotary converter operating alternating to direct-current are to be installed. This substation will supply power to the recently completed Saratoga Division of the system connecting the main line at Mechanicsville with the Saratoga-Ballston line at Ballston Spa. After the alternating current generating plant is installed next year on the Hudson River, the generating and substation apparatus now in use and in course of installation will be displaced by eight 300-kw., 600-volt direct-current rotary converters. All of the electrical apparatus for the temporary installations and also for the permanent equipment of substations is to be built and furnished by the Westinghouse Electric & Manufacturing Company.

Important Changes in the Gold Car Heating Company.

The Gold Car Heating and Lighting Company, which has just been incorporated under the laws of the State of New York, with a capital of $1,000,000, as announced by us last week, has purchased outright the entire business of the Gold Car Heating Company of New York, Chicago and London, and also the entire business of the Gold Street Car Heating Company. It takes possession July 1, 1902, of all of the property of both of these companies, and in addition to nearly one hundred patents already owned by them, has acquired a number of new and valuable patents covering electrical apparatus.

The business of the Gold Companies has increased enormously during the past few years, and now extends all over the world, wherever railway cars are operated by steam or electricity. The Gold Companies have a larger number of unfilled contracts on their books just now than ever before in the history of their business. At the present time they are engaged in equipping new cars or locomotives being built for the following railroads: New York Central, Lake Shore & Michigan Southern, Jersey Central, Delaware, Lackawana & Western, Lehigh Valley, Norfolk & Western, Philadelphia & Reading, New York, Ontario & Western, Chesapeake & Ohio, Southern, Atlantic Coast Line, Plant System, Alabama Great Southern, Waycross Air Line, Cincinnati Southern, Nashville, Chattanooga & St. Louis, Louisville & Nashville, Northern Pacific, Minneapolis, St. Paul & Sault Ste. Marie, Chicago, Burlington & Quincy, Missouri Pacific, Texas & Pacific, Denver & Rio Grande, Union Pacific, New Orleans & North Eastern, and many others.

The foreign business of the company is larger now than ever before, over two thousand sets of car heating apparatus being under construction for shipment abroad within the next three months.

Among the large electric heater contracts recently received is one from the Louisville Railway Company for over three hundred sets of car heating apparatus, and orders from the Jersey Street Railways for about one hundred equipments, as well as from the Boston & Maine, New York, New Haven & Hartford, Massachusetts Electric Companies and South Side Elevated Railroad of Chicago. A contract has recently been closed with the Metropolitan Street Railway of New York for electric heating apparatus which will be a departure from anything of this character hertofore undertaken.

In addition to all of the new work now under way, the Gold Companies have already equipped nearly forty thousand cars and locomotives on about five hundred railroads all over the world, and their apparatus is spoken of in the very highest terms wherever it has been used.

The capital of the Gold Car Heating and Lighting Company, which takes over all of this business, of $1,000,000, has been more than fully paid. There are no bonds on the new company and there is no preferred stock. Its capital is represented by ten thousand shares of common stock of the par value of one hundred dollars each, fully paid, and non-assessable, and the company has no other liabilities whatever. The net value of the property taken over by the new company is $1,090,000.

Mr. Edward E. Gold, of New York City, has already been elected president of the new company and made chairman of the executive committee. All of the stockholders of the old companies will be numbered among the stockholders of the new company, the plan having received the unanimous approval and consent of every shareholder in all of the properties purchased. The main office of the new company will be at Frankfort and Cliff Street, New York City.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 4¼@ 4½ per cent. for 60 to 90 days and 4½ to 4¾ for four to six months. There was greater strength and further activity in the stock market during the past week, the stocks of special interest being those of the southwestern, Pacific and Granger roads. The United States Steel stocks developed weakness and there was general selling, due to the decision against the preferred stock conversion and a possible entire abandonment of the scheme. There was much more public interest in the market and considerable buying of both bonds and stocks for investment purposes. At the close of the week the market was dull but firm. Industrials took a second place as compared with railroad shares. Amalgamated Copper shares seemed to be out of favor owing to the belief that improvement in the copper trade has not been maintained. The traction stocks were neglected and closed weak. Brooklyn Rapid Transit closed at 66½, after having reached 67½, being a net loss of ⅝-point. Metropolitan Street Railway closed with a net loss of ¼-point, the last quotation being 150½. This stock, like Brooklyn Rapid Transit, fluctuated within narrow limits, the highest price being 151⅞. General Electric reached 314 and fell at one time to 305, closing at 306, this being a net loss of 7¼ points. Westinghouse, both common and preferred, were firm, the former closing with a net gain of ½-point and the latter, 2¾; the closing prices were 210½ and 217, respectively. Western Union closed at 92½ ex-dividend. Other closing quotations were American Telegraph & Telephone, 177¼, being a net gain of 3⅛ points, and American District Telegraph, 36. In Boston, General Electric dropped off 12½ points and American Telegraph and Telephone advanced 1¼ points.

NEW YORK.

	June 17.	June 24.		June 17.	June 24.
American Tel. & Cable..	—	87	Gen. Carriage (n. st'k)..	4¾	5¼
American Tel. & Tel....	177¼	175	Hudson River Tel.....	104	—
American Dist. Tel.....	—	35	Metropolitan St. Ry....	151⅜	148
Brooklyn Rapid Transit.	67⅛	66⅝	N. E. Elec. Veh. Trns..	—	—
Commercial Cable.....	—	—	N. Y. E. V. T. Co.....	13	13
Electric Boat.....	28	28	N. Y. & N. J. Tel.....	166	—
Electric Boat pfd.....	40	40	Tel. & Tel. Co. of Am...	—	—
Electric Lead Reduc'n..	2¾	3	Western Union Tel.....	92	89⅞
Electric Vehicle.....	6½	7½	West. E. & M. Co.....	—	210
Electric Vehicle pfd.....	13	15½	West. E. & M. Co. pfd..	217	206
General Electric.....	305	305			

BOSTON.

	Holiday.	June 24.		Holiday.	June 24.
American Tel. & Tel.....	—	175¼	Mexican Telephone.....	—	2¼
Cumberland Telephone..	—	—	New Eng. Telephone....	—	146
Edison Elec. Illum.....	—	—	Westinghouse Elec.....	—	—
Erie Telephone.....	—	—	Westinghouse Elec. pfd..	—	—
General Electric pfd....	—	—			

PHILADELPHIA.

	June 17.	June 24.		June 17.	June 24.
American Railways.....	45½	45½	Phila. Traction.....	98	98½
Elec. Storage Battery....	90	88	Phil. Electric.....	5⅜	5⅜
Elec. Storage Bat'y pfd..	90	88	Pa. Elec. Vehicle.....	1¼	1
Elec. Co. of America....	7¼	7¼	Pa. Elec. Vehicle pfd....	3	3

CHICAGO.

	June 17.	June 24.		June 17.	June 24.
Central Union Tel.....	90	—	National Carbon pfd....	95	96½
Chicago Edison.....	179	180*	Northwest Elev. com....	36⅝	34
Chicago City Ry.....	207¾	205	Union Traction.....	18¼	17½
Chicago Teleph. Co.....	170	160	Union Traction pfd.....	52½	—
National Carbon.....	24½	22¾			

* Asked.

NORTH AMERICAN ANNUAL shows total receipts for year ending May 31, 1902, of $2,103,188, and refers to its various changes and acquisitions during that time. In the last annual report the purchase of the Gas, Electric & Water Companies, in Covington, Newport, Dayton, Ludlow and Bellevue, and their consolidation into the Union Light, Heat & Power Co., in which the company has control, was announced. Since then a consolidation has been effected with the Cincinnati, Covington and Newport Railway Company and the North American has received preferred and common shares in the new company, namely, Cincinnati, Covington and Newport Light and Traction Company. The earnings, both gross and net, are rapidly increasing, the property is efficiently managed, the preferred shares are already on a dividend basis, and it seems assured that a surplus will be earned from the outset which will warrant dividends on the common. In the summer of 1901, negotiations were entered into with the Imperial Electric Light, Heat & Power Co., of St. Louis, which resulted in the purchase of the entire capital stock. Upon this sale a consolidation was effected with the Citizens' Electric Lighting & Power Co., under the corporate name of the Union Electric Light & Power Co. The Citizens' Company has a contract for public lighting in St. Louis, dated Sept. 1, 1900, upon favorable terms and for ten years. It is believed that the prospects in St. Louis are unusually favorable and that business will show a continuous and satisfactory growth. The consolidated company has been awarded by the Louisiana Purchase Exposition Company a contract for about one-half the current for the World's Fair in 1904, and all capital that may be required will be furnished by a syndicate. The North American retains ownership of the Milwaukee Electric Railway & Light Company, and the development of its earning capacity during the year has been even greater than expected.

NEW ENGLAND TELEPHONE.—The directors of the New England Telephone Co. have ordered that 36,047 shares of stock be offered to stockholders at par. Each stockholder of record July 1 will be entitled to subscribe for the new stock in the proportion of one new share for every five then held. The recent authorized increase of $10,000,000 in the capital stock will be sufficient to meet all new construction requirements for several years. The steady growth of the company's business, averaging about 15,000 new subscribers annually, requires over $2,000,000 new capital each year for new construction. The company has 44,969 subscribers in what is called Greater Boston, which compares with 30,809 a year ago. Last year the New England Telephone Co. expended $2,030,092 for new construction, and charged to operating expenses for repairs and maintenance $1,771,290, a total of $3,801,383, as against an expenditure for similar purposes the previous year of $3,153,501. This year it is estimated that $2,250,000 will be spent for new construction, and it is very possible that this sum will represent the new stock to be offered to stockholders next month at par. A year ago the company issued $2,577,400 new stock on the basis of one share for each six held.

DIVIDENDS.—The directors of the Brooklyn Union Elevated have declared a regular dividend of one per cent on the preferred stock, payable June 30. The last previous dividend paid by Brooklyn Union Elevated was two per cent on June 29, 1901. Philadelphia Company, of Pittsburg, directors have declared the regular quarterly dividend of one and one-half per cent. on the common stock, payable July 21. The directors of the United Traction & Electric Co, of New Jersey have declared the regular quarterly dividend of one per cent., payable July 1. Under provisions of the lease of the West End Street Railway Co., to the Boston Elevated Railway, a dividend rental of $2 per share will be paid to stock of record July 1. The directors of the Washburn-Moen Company have declared the regular quarterly dividend of one and three-quarters per cent upon the preferred stock, payable July 1. The Electric Company of America has declared an extra dividend of $1.50 per share, payable July 21. Directors of the Washington Water Power Company have declared the regular quarterly dividend of one and one-quarter per cent., payable July 1. The Columbus, O., Edison Co. has declared the regular semi-annual dividend of three per cent. on the preferred stock. A dividend of 75 cents per share has been declared on Reading Traction Stock.

A LONG ELECTRIC ROAD.—The organization of the New Orleans and Southwestern Electric Railway Company, with a capital stock of $2,000,000, has been effected at New Orleans. C. P. Shever was elected president; C. P. Young, general manager; H. L. Lancaster, treasurer, and Thomas A. Badeoux, secretary. It is the purpose of the company to build immediately an electric railway line from New Orleans through the Louisiana sugar and rice belt. The distance will be about 200 miles, and the road will be constructed with a view of handling the heaviest kind of freight. It is determined to begin the actual work of construction on July 10. A Boston syndicate is behind the enterprise.

A LARGE TELEPHONE SYNDICATE.—The Consolidated Telephone Co. has been formed at Buffalo, N. Y., with a capital of $10,000,000, to acquire telephone exchanges in New York and adjoining States.

STANLEY STOCK.—It is stated from Philadelphia that the Stanley Electric Mfg. Co., of Pittsfield, has increased its capital stock by $1,000,000, making the total capital $4,000,000.

A PHILADELPHIA VIEW.—The "Wall Street Journal" has the following: An Electric Storage Battery Co. interest says: "The purchase of the Stanley Electric Mfg. Co. was a great stroke of business for the Electric Storage Battery Co. The Battery Company has never entered this field before, but the Stanley Company makes the same line of goods that the General Electric and Westinghouse companies do. The Stanley Company can be used as a 'club' by the Battery Company in competing with the other two companies for electrical plant equipment, much to its advantage. It will now be able to contract for the dynamos and motors of a plant as well as for the storage battery, and the company can show the consumer that he can put up a smaller plant than would be necessary without a storage battery. Although the Electric Storage Battery Co. may not directly take over the Stanley Mfg. Co., it will be controlled by the same people."

AMERICAN RAILWAYS COMPANY.—The gross earnings of the American Railways Company for the month of May, 1902, amount to $97,701, as against $73,406 for the corresponding month of the previous year, showing an increase of $24,295. These earnings include the full operation of the Chicago & Joliet Electric Railway Company, whose earnings increased from $12,905 in May, 1901, to $24,782 for the month of May, 1902, a change of almost one hundred per cent. The gross earnings for 11 months of this year and last compare as follows: In 1901-2, they were $908,550; in 1900-1 they were $763,959.

PENNSYLVANIA-NEW YORK TUNNEL.—For its right to enter New York City by an electric road under the Hudson, the Pennsylvania Railroad has agreed with the New York Board of Rapid Transit Commissioners to pay $75,535 per year for the first ten years for franchise, rights, etc., and $114,871 for each of the next fifteen years. The franchise allows five years for the completion of the work.

A BIG MORTGAGE.—The United States Illuminating Company and the United Electric Light & Power Company, which were merged some time ago, have mortgaged their property to the Union Trust Company. The mortgage is for $10,000,000 five per cent. gold bonds and runs for 30 years, and is subject to the United Electric Light & Power Company's prior mortgage.

COLUMBUS EDISON.—The Columbus, O., Edison Company is to issue $100,000 of preferred stock at par, to be allotted to the stockholders of both preferred and common stock in the proportion of one share of new stock for eight shares of stock held by the stockholder.

THE ELECTRIC COMPANY OF AMERICA has notified its stockholders that by resolution of the board of directors, duly authorized by the stockholders thereof, a final assessment, being the sum of $2.50 per share, has been levied and is now called for.

Commercial Intelligence.

THE WEEK IN TRADE.—In summarizing the situation in trade *Bradstreet's* states that the conditions governing present and future trade show very sharp contrasts, the immediately present situation being clouded by the rather less favorable industrial outlook and the prospect of an extension of the coal strike in the bituminous fields. The continued favorable progress made by all the leading crops lends assurance that once the present strained condition of industrial affairs is relieved, a large and prosperous fall and winter business is assured. The scarcity of pig iron is causing a noticeable stiffening in prices. Structural material and bar iron are strong, but wire and sheets are dragging. An order for 28,000 tons of steel rails for South Africa for delivery this year has been refused because of orders ahead preventing delivery. The business failures of the week, as reported by *Bradstreet's*, numbered 177 as against 165 the previous week and 188 the same week last year. The copper market remains dull and without feature. There was little business and little offering to sell. Lake is quoted at 12¼@12½c., electrolytic in cakes, wire bars and ingots, 12@12½c., in cathodes, at 11¾@12c. and casting stock 12c.

VARIOUS HARRISBURG ENGINE ORDERS.—The Harrisburg Foundry & Machine Works, of Harrisburg, Pa., reports having recently received several orders for their engines. The Gould Coupler Company for installation in its Depew, N. Y., plant, for both light and power use, has ordered a 300-hp. Harrisburg standard engine, which is to be direct connected to a 200-kw. generator to be built by the Bullock Electric Manufacturing Company, of Cincinnati, O. The Salts Textile Manufacturing Company, of Bridgeport, Conn., has called for a 120-hp. standard engine for direct connection to a 75-kw. generator of the Walker type built by the Westinghouse Electric and Manufacturing Company. These machines are to be used for light and power. J. E. Doane, of Thompson, Conn., has ordered a complete steam plant from the Harrisburg people for lighting his private estate. It will consist of a 120-hp. standard engine and a 75-kw. generator built by the Stanley Electric Manufacturing Company, of Pittsfield, Mass. The Thompson-Starrett Company, of New York, has ordered nine Harrisburg engines, aggregating 965 hp. One 225-hp., one 150-hp. and two engines, each of 120-hp. standard engines direct connected to 150-kw., 100-kw. and 75 kw. generators, built by the General Electric Company are to be installed for light and power use in a new apartment house at Sixty-seventh Street and Broadway, New York. In an apartment house on Thirty-fourth Street near Seventh Avenue, a 120-hp. standard engine and one 75-hp. are to be put in. These engines will be direct connected for light and power purposes to 75-kw. and 50-kw. General Electric generators. In the Pennsylvania Building, Philadelphia, three 75-hp. Harrisburg standard engines, direct connected to 50-kw. General Electric generators, are to be installed. These sets are intended for lighting use only. The People's Electric Light and Power Company, of Easton, Pa., has placed an additional order with the Harrisburg people for a 450-hp. tandem compound vertical engine for direct connection to a Northern generator of 300-kw. capacity, also for a 150-hp. belted engine to be used in connection with a 100-kw. Northern generator.

SOME FOREIGN AND DOMESTIC C & C ORDERS.—The C & C Electric Company, of Garwood, N. J., reports receipt within the last ten days of a number of contracts for the foreign and domestic markets. The Montezuma Lead Company of Mexico has placed an order—the third one—for a 65-kw. generator and switchboard for power purposes, and a cable order received from Chas. R. Heap, of London, S. W.—the C & C Company's representative in Great Britain—calls for the immediate shipment of five dynamos and motors of various sizes. Lyon & Healy, the big music publishers of Chicago, have sent a second order for a 150-kw. generator to be direct connected to a 225-hp. engine to be built by the Ames Iron Works, of Oswego, N. Y. This equipment will be used for light and power purposes in the new buildings of the Western concern. The Vulcanized Fibre Company, of Wilmington, Del., has also given a second order for a 40-kw. C & C generator for power use. Four motors varying from 10-hp to 25-hp have been ordered for installation in the Hanover National Bank Building, now under construction at Nassau and Cedar Streets, New York. These motors will be utilized for operating ventilating apparatus. The Monarch Silk Company, of York, Pa., is to be furnished with a 50-kw. engine type generator to be direct connected to a 75-hp. Harrisburg standard engine. This outfit is intended to furnish light. The Central Realty Company, of 907 Seventh Avenue, New York, has ordered two 50-kw. generators and one 30-kw. machine for installation in new apartment houses and the Seaboard Realty Company, of 127 West Forty-second Street, has called for six 75-kw. generators and four 60-kw. generators, also for apartment houses, where the machines are to be used for both light and power purposes.

WIRING AND CONDUIT ORDERS FOR PHILIPPINES CRUISERS.—F. W. Horrie, of Yokohama, the pioneer and largest handler of American machinery in the Far East, who, it will be recalled, is now in the United States placing large contracts—some particulars of which have already appeared in these columns—has given an order valued at nearly $10,000 to Joseph Barr, of New York, for the wiring requisite for ten of the fifteen cruisers now under construction in Japanese and Chinese shipbuilding yards for the Philippines Insular government. R. B. Corey, of New York, has been allotted an order by Mr. Horrie for loricated conduit for use in these vessels. Mr. Horrie will be in this country for some three weeks yet, and expects to close some further contracts in the interim. He is stopping at the Hotel Manhattan. Downtown he may be found at the offices in the Maritime Building, Bridge Street, of Alfred H. Post & Company.

EDDY PLANT SOLD.—The property of the Eddy Electric Company of Windsor, Conn., has been sold by order of the Superior Court of Connecticut for $35,000. The purchaser was Mr. Hinsdell Parsons, presumably for the General Electric Company.

ELECTRICAL EXPORTS FROM SAN FRANCISCO.—The exports of electrical material from the port of San Francisco, during the month of May reached a valuation of $10,658.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended June 21, 1902. Argentine Republic—117 pkgs. material, $3,914. Amsterdam—1 pkg. machinery, $119. Antwerp—12 pkgs. material, $257, 3 pkgs. machinery, $224. Berlin—3 pkgs. material, $65. British Australia —1 pkg. material, $44. Brazil—41 pkgs. material, $1,178; 11 pkgs. machinery, $3,346. British East Indies—1 pkg. material, $13. British West Indies—62 pkgs. material, $1,639. Cuba—11 pkgs. material, $235. Chile—4 pkgs. material, $932. Copenhagen —2 pkgs. machinery, $52. Dutch West Indies—5 pkgs. material, $43. Dutch Guiana—2 pkgs. material, $26. Ecuador—67 pkgs. material, $390. Glasgow—49 pkgs. machinery, $2,843; 32 pkgs. cable supplies, $14,040. Havre—19 pkgs. material, $355. Hamburg—37 pkgs. machinery, $2,403; 135 pkgs. goods, $8,492. Lisbon—1 pkg. material, $36. London—23 pkgs. machinery, $3,330; 181 pkgs. material, $2,987. Liverpool—262 pkgs. machinery, $16,018; 28 pkgs. material, $1,085. Mexico—122 pkgs. material, $3,229; 35 pkgs. machinery, $1,625. Manchester—26 pkgs. material, $1,261; 99 pkgs. machinery, $10,934. Marseilles—11 pkgs. material, $125. Newfoundland—7 pkgs. material, $180. New Castle—10 pkgs. machinery, $640. Novorossick—1 pkg. machinery, $36. Nova Scotia—4 pkgs. material, $229. Peru—13 pkgs. material, $170. Rotterdam—2 pkgs. machinery, $85. Southampton—2 pkgs. material, $136; 241 pkgs. machinery, $10,875. U. S. Colombia—24 pkgs. material, $928. Uruguay—3 pkgs. material, $45.

INDUCTION MOTORS AT THE CONTINENTAL IRON WORKS.—The Continental Iron Works, of Brooklyn, N. Y., the builders of the famous "Monitor," have recently purchased from the Westinghouse Electric and Manufacturing Company considerable additions to their electrical equipment. The purchase includes a 180-kw., 220-volt, 60-cycle, two-phase alternator, a five-panel switchboard, eleven induction motors of from 5 to 20-hp. each, with the accompanying auto-starters. The company some time ago installed alternators of 120-kw. and 45-kw. each, and of the same characteristics as the above. They also have quite a number of induction motors in use driving corrugating and bending rolls for making fire-boxes, also driving fans, shears, tools in the machine shop, etc. Some of the motors which have recently been purchased are to displace direct-current motors, the original installation at this particular plant having been of direct-current apparatus. Afterwards a 45-kw. alternator was put in to try alternating current distribution and subsequently the 120-kw. and 180-kw. alternators have been purchased. The direct-current motors are rapidly being replaced by alternating-current induction motors, and this is after a thorough and careful investigation of the subject and several years' trial of the induction motors. In fact, when the new 180-kw. alternator is installed, the old direct-current generator will be used as an exciter, also furnishing current to one or two small direct-current motors which will be used for a while until they are worn out.

THE ARNOLD MAGNETIC CLUTCH COMPANY.—A matter of more than usual interest in the electrical manufacturing field is the recent formation, in Milwaukee, of the Arnold Magnetic Clutch Company with $100,000 capital, to manufacture magnetic clutches of the design of B. J. Arnold as patented and used by Mr. Arnold in power station work; also magnetic clutches for other important purposes. The officers of the Company are well known in the electrical field and consist of F. R. Bacon, president; H. H. Cutler, vice-president; A. H. Berresford, secretary; F. L. Pierce, treasurer, and Bion J. Arnold, consulting engineer. Land has been purchased at Milwaukee, and a factory equipped with special tools suitable for this work will be in operation within the next three months. The company will not be in shape, however, to deliver clutches until its factory is completed. In the meantime a large number of designs will be developed for various purposes including, in addition to the Arnold clutches now in use, some new types upon which H. H. Cutler has been working. This will be the pioneer manufacturing company in a hitherto almost uncultivated field of magnetic clutch work, and the completion of the factory and the announcement of designs will be awaited with great interest.

WESTINGHOUSE CONTRACTS.—The Tom Boy Gold Mines, of Pandora, Colo., are being equipped throughout for electrical power distribution. A recent purchase from the Westinghouse Electric & Mfg. Co. includes a number of induction motors, reducing transformers, "low-equivalent" lightning arresters with choke coils and high-tension circuit breakers. The Riter-Conley Mfg. Co., of Pittsburg, Pa., has recently decided to adopt alternating-current motors exclusively for power distribution. It has purchased three 200-kw. engine-type Westinghouse generators which are to be direct connected to Westinghouse gas engines using natural gas. Alternating currents will be used for all work, including cranes, and a number of induction motors will be geared directly to straightening rolls. The Steubenville & Wheeling Traction Co. has just purchased two 500-kw Westinghouse railway generators, to be used in the operation of an electric railway running from Steubenville, Ohio, to Wheeling, W. Va., and, also, a line from Wellsburg to Wheeling.

THE ELECTRICAL EQUIPMENT COMPANY, Suite 939 Monadnock Block, Chicago, Ill., has been awarded a contract for the complete installation of a 2500-hp. electric transmission plant, located on the St. Joe River, at Constantine, Mich. The equipment includes six 400-hp. and two 60 hp. water wheels to operate under a twelve-foot head. The main drive will be divided into two sections, with three of the larger wheels geared to each shaft, which is direct connected to a 600-kw. revolving field, alternating current generator. Each of the small wheels will be direct connected to a 35-kw. direct-current generator to furnish exciting current for the alternators. In addition to furnishing power for manufacturing purposes, the commercial and city lighting of Constantine, Three Rivers, and White Pigeon will be operated from this plant. Several new industries, including a calcium carbide plant will be located at Constantine to utilize this power. The plant will be in operation December 1, 1902.

ELECTRICITY IN THE ORANGE GROVES.—The San Antonio Water Company of Ontario, Cal., Mr. W. H. Sanders, chief engineer, has just placed an order with the Abner Doble Company of San Francisco, for a third water wheel unit to be installed at its power plant which is now in course of construction in the Sierra Madre Mountains. These three wheel units are designed to develop 460-hp. each at 375-rpm. under a total head of water of 694 feet, and will be direct connected to 250-kw. General Electric generators. With the water wheel units will be furnished "Doble" needle regulating nozzles controlled by Lombard governors. The power developed will be transmitted to the orange groves in the vicinity of Ontario, Cal., and will be utilized for actuating motor-driven pumps for irrigating purposes. The stockholders of this company are the principal orange growers located in that section of the country.

A 2290-HORSE POWER WESTINGHOUSE GAS ENGINE PLANT.—The water works department of the city of Philadelphia has just placed a contract for what is said to be the largest of its description ever awarded in the United States for gas engines to be installed in a municipal plant. The contract, which was secured by W. C. Muckle, Jr., & Company, of Philadelphia, acting as agents for Westinghouse, Church, Kerr & Company, calls for a plant of 2290-hp. capacity. There are to be eight three-cylinder engines of 280-hp. each and two of 125-hp. They are intended to be direct-connected to pumps for the purpose of increasing the water service of the city fire protection system.

THE SAN GABRIEL ELECTRIC CO., of Los Angeles, Cal., has recently purchased a 750-kw., two-phase, engine-type Westinghouse generator which is to be installed in a substation of the Pacific Light & Power Co. The latter company has recently acquired the San Gabriel Company and the new alternator will be used in connection with its general system of lighting and power in Los Angeles and the vicinity.

STORAGE BATTERIES IN CUBA.—The Electric Storage Battery Company of Philadelphia announces that Mr. G. F. Greenwood, 34 Empedrado Street, Havana, Cuba, has been appointed agent for the sale of "the Chloride accumulator" in Cuba. All inquiries and business from that section should be forwarded to Mr. Greenwood and will receive from him prompt attention.

NEW TRACTION PROJECT IN BUENOS AYRES.—Varela Cuneo & Company, of Buenos Ayres, Argentine Republic, are expected to decide by July 31 as to the construction of a new electric traction system from Rivadavia, located on the outskirts of Buenos Ayres, going to the Tigra and passing through all the northern suburbs.

LIGHTING EQUIPMENT WANTED IN SOUTH AMERICA.—The River Plate Electric Light and Traction Company has closed a contract with the municipality of Rosario for the lighting of that South American city and will let contracts shortly for power house equipment, cables, etc.

MICA WORKS.—The General Electric Company has, it is stated, purchased property in the city of Ottawa, and has now a large force of men at work in improving the buildings and fitting them up for operation. Machinery is also being installed for the purpose of sorting and trimming mica.

THE SAN LUIS ELECTRIC COMPANY, of San Luis Potosi, Mexico, is about to considerably extend its operations. Chief Engineer Corbett and General Manager Waddell are now in the United States getting figures on equipment.

General News.

THE TELEPHONE.

ST. AUGUSTINE, FLA.—The Southern Bell Telephone Company has obtained the privilege of building long distance lines. A line to Jacksonville will be built and later a line to Palatka and other points connecting with the southern long-distance circuit.

TALLAPOOSA, GA.—The Gainsboro Telephone Company is installing a $2,000 exchange. The company has constructed some 200 miles of lines.

ATLANTA, GA.—C. J. Simmons, one of the receivers of the Standard Telephone Company, has filed his bond of $20,000 with the National Surety Company, of New York. The work of the telephone company will in no way be affected by the receivership.

TROWBRIDGE, ILL.—The Trowbridge Mutual Telephone Company has been incorporated, with a capital stock of $1,500. The incorporators are Henry C. McClory, John C. Quinn and Barnard Wilson.

HARDIN, ILL.—The Calhoun Telephone Company will lay a cable across the Illinois river at the Deer Plain Ferry, and connect with the Bell Telephone Company long-distance line at Grafton.

CHICAGO, ILL.—The Marissa Telephone Company, of Marissa, has been incorporated by J. A. Hamilton, Henry Finger and R. S. Coulter; capital, $2,500.

SPRINGPORT, IND.—The Springport Telephone Company has been organized with a capital of $4,000.

WINCHESTER, IND.—The Eastern Indiana Telephone Company has increased its capital stock to $5,000. New lines will be built and new cables installed.

VINCENNES, IND.—The Knox County Telephone Company has incorporated with a capital stock of $25,000; incorporators: W. H. Vallmer, Vincennes; D. A. Yoder, Cleveland, O.; Slinkard, Bloomfield, and J. E. Gardner, Bryan, O.

BLOOMINGTON, IND.—The Monroe County Telephone Company has filed articles of incorporation. The company's capital is placed at $5,000. The directors are A. F. and Arra McCormick, J. A. Luzzarder, F. P. Woodard and H. A. Leed.

BRAZIL, IND.—The Citizens' Telephone Company, of Clay County, has filed articles of incorporation. Capital stock, $50,000. The directors are J. G. H. Klingher; S. M. Slegter, M. J. Murphy, T. W. Englehart and H. D. Falls, all of Brazil.

ANDERSON, IND.—The county commissioners of this (Madison) county have granted a franchise to the Anderson Telephone and Telegraph Company, of Indiana, to construct and operate its lines throughout the county. The company is building a line from Indianapolis to Marion through this city. The terms of the franchise are that the company pay the county $360 and furnish the county offices free instruments. The commissioners at the same time caused the arrest of a crew of workmen for the American Telephone Company which had proceeded to distribute poles and wires along the public highways without right. The American Company had applied for a franchise, but refused to comply with some of the demands of the commissioners and the franchise was not granted.

MOVILLE, IA.—The Arlington Telephone Company has been organized with a capital of $5,000.

DES MOINES, IA.—Whitebreast Mutual Telephone Company of Lacona has been incorporated; capital, $1,000.

CARROLL, IA.—The Harris Jewell Telephone Company has been organized with A. C. Steel as president.

MARSHALLTOWN, IA.—The Cedar Valley Telephone Company has just completed the construction of a new line from Eagle Center to Hudson.

BARBOURVILLE, KY.—The Knox Telephone Company has been granted a franchise to operate a line to Corbin. Branch lines to various county points will also be built.

NEW ORLEANS, LA.—The Cumberland Telephone and Telegraph Company has been granted the privilege by the Railroad Commission to abolish its ten party lines, thus doing away with its cheaper service. There are about 500 subscribers to the ten party line service.

IRON MOUNTAIN, MICH.—At the recent annual meeting the Menominee Range Telephone Company re-elected old directors and declared a dividend of eight per cent. Despite the strong opposition of the Bell company the new company is exceedingly prosperous. Eight exchanges and two toll stations are maintained. A number of extensions are planned.

SEDALIA, MO.—The Queen City Telephone Company, of this city, has filed articles showing that it had increased its capital stock from $50,000 to $100,000.

ALEXANDRIA, MO.—The Illinois Western Telephone Company, of Illinois, has filed articles showing a capital stock of $200,000, of which $50,000 is to be used in Missouri, with an office at Alexandria.

ADRIAN, MO.—The telephone system recently completed here by the Austin Inland Telephone Company has been formally opened to the public. The company will soon connect this place with the neighboring towns of Austin, Altoona, Butler, Burdette and Harrisonville.

MANCHESTER, N. H.—The Amoskeag Manufacturing Co., of this city, is about to install in its plant a private telephone system of about 40 stations. There will be no control.

NEW LISBON, N. J.—The Farmers' Telephone Company of New Lisbon, N. J., capital, $100,000. Incorporators: Henry M. Black, New York City; M. Warner Hargrove, Brown's Mills, N. J., and William H. Reeves, New Lisbon, N. J.

ALBANY, N. Y.—The East Fishkill Telephone Co., of Hopewell Junction, Dutchess County; capital, $5,000, has been incorporated. Directors: H. D. White, Charles Underhill and John Rapelye, of Hopewell Junction .

SYRACUSE, N. Y.—The Central New York Telephone & Telegraph Co. is rebuilding all its toll lines and is putting them on a copper metallic basis. The company has lines in nine counties and 1,200 miles of line will be rebuilt.

CHADBOWN, N. C.—The Columbus Telephone Company has been chartered with a capital of $5,000. The incorporators are T. G. Hyman, F. R. Hyman and C. B. Hyman.

GREENSBORO, N. C.—For the purpose of foreclosing a mortgage held by L. W. Floyd and G. A. Browning, the property of the Home Telephone Company will be sold by A. G. Furman, trustee, at public auction.

BEREA, OHIO.—The Citizens' Telephone Company will install an exchange at Royaltown.

OXFORD, OHIO.—The Oxford Telephone Company has secured a franchise in Oxford.

LONDON, OHIO.—The Madison-Clark Telephone Company will build an exchange at South Solon.

CADIZ, OHIO.—The Harrison County Telephone Company is installing an exchange at New Athens.

BARTLETT, OHIO.—The People's Telephone Company of Washington County has increased its capital stock from $2,000 to $5,000.

SPENCERVILLE, OHIO.—The Spencerville Telephone Company has increased its capital stock from $20,000 to $40,000 to provide for improvements. Albert C. Buss is president.

YOUNGSTOWN, OHIO.—On account of the recent increase in rates by the independent company, the Retail Grocers' Association is debating the advisability of adopting only one telephone system and all using it.

LONDON, OHIO.—Manager N. E. Liggett, of the Marysville Telephone Company, has bought out the Plain City Company operating the line between Marysville, New Dover and Watkins. The lines will be rebuilt.

FINDLAY, OHIO.—The Central Union Telephone Company has announced the second cut in rates within two months. The Findlay Home Telephone Company is making a strong bid for business, and the cut is the result.

YOUNGSTOWN, OHIO.—After July 1 the rates of the Youngstown Telephone Company will be increased from $18 to $24 for residences and from $25 to $36 for business. Business houses can secure service on a party line of two at $24.

VERMILLION, OHIO.—The Vermillion Telephone Company has organized with the following officers: E. L. Coen, president; R. F. Quigley, vice-president; C. C. Barnhart, secretary; Charles H. McGraw, treasurer. The company has secured 100 contracts and will commence operations as soon as possible.

CLEVELAND, OHIO.—Drake, Barnes & Company, of this city, have secured a perpetual franchise to operate telephone exchanges at Clearfield and Curwinsville, Pa. The franchise previously secured by the Bell company has been rescinded. The Clearfield Telephone Company will be incorporated to operate exchanges in both places.

CANTON, OHIO.—Strike of the linemen employed by the Stark County Telephone Company has been adjusted by concessions on both sides. In the future the men will receive $2.50 per day, regular foreman $3 and general foreman $3.50. Nine hours constitutes a day's work; time and a half for overtime and double time for holidays.

GALION, OHIO.—The Galion Telephone Company, which was recently sold by the Federal Telephone Company, has been reorganized with the following officers: Mark Cook, Mt. Gilead, president; U. A. Whitney, Mt. Gilead, vice-president; S. M. Wolf, Bellevue, treasurer; John W. Cupp, Galion, secretary; C. R. Callaghan, Bellevue, general manager.

CINCINNATI, OHIO.—The Cheviot, Mt. Airy & Groesbeck Telephone Company has been incorporated with $5,000 capital, to extend and operate a telephone line in Hamilton County. The principal office will be at Cheviot. The incorporators are: Robert R. Conger, Fred. C. Walhers, Avery Markland, Frank W. A. Bonner, Henry Frendorf, Nick Ruehel and George L. Ruehel. The company will operate an independent line from Mt. Airy to Groesbeck, to Cheviot, and eventually to Cleves. It is understood that in course of time the new company will take in the other telephone lines in that part of the county.

CLEVELAND, OHIO.—The Everett-Moore syndicate recently took under consideration a proposition made by leading independent telephone people of Columbus, Dayton and other large cities for the sale to the latter of the long distance lines of the United States Telephone Company, the total capital stock of which company is owned by the Federal Telephone Company. It is authoritatively announced that the deal has been declared off and that in all probability the United States long distance system will remain in the hands of the Everett-Moore people.

COLUMBIA, S. C.—Three new telephone companies have just been commissioned in South Carolina, viz.: The Lancaster Telephone Company, capital $5,000, J. T. Thompson being interested; the Bedford Telephone Company of Yorkville, capital $5,000, by W. B. Moore and W. W. Lewis, and the Blacksburg Telephone Company, capital $3,000, by W. B. Moore, of Yorkville, and A. M. Bridges, of Blacksburg.

KNOXVILLE, TENN.—The Cumberland Telephone Company has begun a telephone line into Clear Fork Valley.

FORT WORTH, TEX.—Lancaster Telephone Company has been incorporated; capital stock, $10,000.

BARTLETT, TEX.—The Bartlett-Walberg Telephone Company has been chartered by W. P. Powell, O. H. Ward and J. T. Bartlett, capital, $2,000.

CHARLOTTESVILLE, VA.—The Bell Telephone Company has been refused a franchise to enter Charlottesville.

LYNCHBURG, VA.—The Council Committee has refused to renew the Bell Telephone Company franchise unless a provision is inserted fixing a maximum rate for service. The Bell representative has refused to assent to this.

GOOCHLAND, VA.—The Goochland Telephone Company is pushing west to Silking and east to Oilville, a total distance of about 16 miles. A circuit from Goochland direct to Richmond will be commenced at once.

WARRENTON, VA.—The Upper Fauquier & Warrenton Telephone Company has been organized and the following officers elected: J. B. Beverly, president, R. W. Hilleary, vice-president, and R. A. McIntyre, secretary and treasurer.

RICHMOND, VA.—Four telephone companies have just filed charters to operate in Virginia, as follows: The Merchants' and Farmers' Telephone Company, of Hanover County, $1,000 to $10,000 capital, H. D. Kerr, of Ashland, is interested. The Farmers' Mutual Telephone System, of Shenandoah County, capital $500 to $5,000. The Buckingham Telephone Company, $500 to $5,000, R. S. Ellis, president. The Farmers' Mutual Telephone Company, of Prince William County, capital $50 to $5,000, C. T. Brower, president.

MADISON, WIS.—The Dane County Telephone Company, with a capital of $10,000, has been incorporated by J. C. Harper, H. C. Winter and H. J. Sutherland.

ASHLAND, WIS.—The Ashland Home Telephone Company has been incorporated with a capital stock of $100,000. The incorporators are C. A. Lamoreaux, J. I. Levy and G. E. Bement.

ELECTRIC LIGHT AND POWER.

TALLADEGA, ALA.—The Talladega Company has secured a franchise for lighting and traction and will have a generating plant at Jackson's Shoals.

SAN FRANCISCO, CALIF.—The Princeton Mine at Mt. Bullion, Mariposa County, Calif., will install 20 additional stamps this summer and adopt electric power.

SAN DIEGO, CALIF.—The City Engineer of San Diego has been instructed by the City Council to make estimates as to the cost of a municipal electric lighting system.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company is building the dam for its new 12,000-hp. electric power plant in Butte County, Calif. Pipe lines will conduct the power water from the dam to the new generating station near Nimshew.

EUREKA, CALIF.—The Eureka Lighting Company's main electric generating station at the corner of First and C Streets, has been destroyed by fire. The estimated loss was $50,000. The town was left in darkness with the exception of a few incandescent lights.

SAN FRANCISCO, CALIF.—The contract for installing the electric motors and pumps for the new water system that is to supply the Salt Lake County farmers with irrigation water has been awarded to J. H. Gardner, superintendent of the Utah Sugar Company. Four pumps will be driven by four Westinghouse motors.

LOS ANGELES, CALIF.—The Western Power Company, of Los Angeles, has commenced work on its electric transmission system in Plumas County. Roads are being opened at several points under the supervision of J. M. Howells, manager and consulting engineer. The waters of the North Fork of Feather River will be diverted and stored. An electric transmission plant is to be installed that will in time be connected with San Francisco.

SAN FRANCISCO, CALIF.—The Supervisors' Committee on Lights recently rejected all proposals for public lighting except those of the San Francisco Gas & Electric Company and the Independent Electric Light & Power Company. The Independent Company offered to light 19 small buildings, including fire-houses, at $.039 cent per kw. hour and the Gas & Electric Company the remaining buildings at $.028. All of the street lighting bids were rejected as too high and also because the charter forbids the city paying any higher rates than the minimum allowed other consumers. At the rates bid it would cost annually $258,560 to keep the streets lighted every night in the year.

SAN FRANCISCO, CALIF.—The Stanislaus Water & Power Company, of San Francisco, will hold a stockholders' meeting on July 21st for the purpose of acting upon a proposition to create a bonded indebtedness to the amount of $2,500,000. The company will install a power plant and transmit current from the Stanislaus River to San Francisco. It will work in harmony with the Standard Electric Co. The Kern River Company, of Los Angeles, has closed contracts for the building of a 12-mile canal, which will convey 30,000 miner's inches of water to the site of the company's electric power plant. The generating station will have a capacity of 15,000 hp. Large grading and lumber contracts have been let and machinery will be ordered at once, but it will probably be nearly a year before the electric manufacturing companies can make deliveries. Electric power will be transmitted to Los Angeles for the use of the Huntington-Hellman syndicate on its electric car lines, to the Pacific Electric Power Company for light and power and to the Redondo Railroad Company for the operation of cars. Electricity will be transmitted also to Bakersfield, Randsburg and San Bernardino and other places. The San Bernardino line is now being constructed. A double pole line 110 miles in length will be built to Los Angeles. Auxiliary steam power plants will be established and kept in reserve.

AUGUSTA, GA.—The Augusta Railway and Electric Company is making great improvements at its plant in Augusta. A 650-hp. Green-Corliss engine has been installed and belted to a direct-current General Electric generator. At the west station twin horizontal turbines have been installed and connected with a 1000-hp. generator.

ATLANTA, GA.—An application for a charter for the Atlanta Manufacturing and Improvement Company, of Atlanta, Ga., capitalized at $300,000, has been filed. The privilege is asked in the charter for increasing the capital to $1,000,000 if necessary. The company proposes to furnish electric power for manufacturing concerns in and about the city.

VENICE, ILL.—Negotiations are under way by St. Louis investors to purchase the Electric Light and Power Company's plant in this city. The plant also furnishes power and light to Brooklyn.

SPRINGFIELD, ILL.—The Lamont Electric Light Company, of Lamont, has been incorporated; capital, $20,000. Incorporators: J. G. Bodenshatz, E. L. Huston and Hubert Sauber.

MUNCIE, IND.—The Muncie Electric Light Company has increased its capital stock from $25,000 to $125,000. H. C. Kimbrough is president of the company.

HARTFORD CITY, IND.—This city is in darkness, the electric light plant is fatherless, and consequently abandoned. The city denies the ownership of the plant and the American Light Company, which installed it, holds that it is the city's property. Litigation may result.

COVINGTON, KY.—The Union Light, Heat and Power Company has been refused an injunction to prevent the city of Covington from issuing municipal light bonds and the city clerk accordingly has advertised for bids for a bond issue of $75,000 par value.

HAGERSTOWN, MD.—It is proposed to dam the Potomac River about 15 miles from Hagerstown and build an electric power house, from which power will be transmitted to Martinsburg, Hagerstown, Williamsport and other places. It is the intention of the promoters to use the power for the operation of street railways and electric lighting in the various towns. Work on the power plant has already begun.

COHASSET, MASS.—The Cohasset Electric Co. is about to install a compound engine, built by the Ball Engine Co., Erie, Pa.

OCEAN SPRINGS, MISS.—John D. Gray has been granted a franchise to operate an electric light and ice plant.

OKOLONA, MISS.—Sealed proposals for the Okolona, Miss., $40,000 5 per cent. water works and electric lighting 20-year bonds will be received until June 30.

RATON, N. M.—The sum of $20,000 will be expended in increasing the capacity of the electric lighting system in Raton. A 200-hp. engine will be installed and an alternating current system will replace the direct.

ALBANY, N. Y.—The Easthampton Electric Light Company, Easthampton, Suffolk County, has been incorporated; capital, $48,000. Directors: Everett Herrick, New York; G. L. McAlpin, S. S. Quackenbush, Easthampton.

COLUMBUS, OHIO.—An electric lighting plant is to be installed in the Palace Hotel.

BUCYRUS, OHIO.—G. A. Myers of this place has secured lighting franchises at Navarre and Strasburg, Ohio. He will organize companies to build the plants.

CINCINNATI, OHIO.—The Cincinnati, Georgetown & Portsmouth Railway Company has secured lighting franchises in Georgetown, Mt. Washington, Amelia and Bethel.

MARYSVILLE, OHIO.—At a recent meeting of the Marysville Light & Water Company Howard Jones was elected to succeed G. M. McPeck as secretary of the company.

CALEDONIA, OHIO—The C. D. Resler Electric Light & Power Company has been incorporated with $5,000 capital stock. Officers have been elected as follows: C. D. Resler, president; J. K. Rogers, vice-president; C. E. Kelley, secretary; E. S. Geddis, treasurer ; C. D. Resler, general manager and superintendent.

GALLIPOLIS, OHIO.—The village clerk of Gallipolis will receive bids to July 15 on 100 arc lamps, 10 three-glower Nernst lamps and 50 16-cp. incandescents. The village will grant a franchise to 10 years for a company which will install a generating plant of 150-kw. or greater, capacity, and will assist in securing business.

SPRINGFIELD, OHIO.—The Citizens' Heating & Power Company has been granted a 25-year franchise for light, heat and power in Springfield. The company is required to pay one per cent of gross receipts from five to ten years, two per cent. from ten to fifteen years and three per cent. from fifteen to twenty-five years.

NILES, OHIO.—The Empire Iron & Steel Company is building a plant at Niles, consisting of six sheet mills, bar mill and squeezers, with scrap and puddling furnaces, waste heat boilers, steel buildings, trestle tracks for unloading, cranes, shears, machine shop and all small machines to operate by electricity. The power plant will comprise Allis engines and Sterling and Cahall boilers.

WINNSBORO, S. C.—The most interesting question at this time is that of issuing bonds to the amount of $10,000 for installing an electric light plant.

COLUMBIA, S. C.—The Cotton States Electric and Machine Company recently reorganized and dealing in electrical supplies, has increased its capital from $5,000 to $15,000. The company has on hand several lighting contracts.

AMARILLO, TEX.—The Amarillo Light & Water Company is erecting an electric light plant, equipped with two 45-kw. General Electric 220-volt dynamos, 12x13 Case automatic high-speed engine and two 125-hp. Morrison internal fired boilers, and water works system equipped with three Cook deep well pumps. The officers are John. W. Porter, president; H. B. Jones, vice-president and general manager; and E. L. Dohany, Jr., secretary and treasurer.

BRISTOL, VA.—The Ordway Manufacturing Company is erecting an electric power plant and proposes to furnish power to numerous industires.

MILWAUKEE, WIS.—The City is considering a site on Jones Island for the proposed city electric lighting plant.

NELSON, B. C.—The town of Nelson is taking steps towards utilizing the water power of the Kootenay River to obtain an increased supply of electrical energy for light and power.

OTTAWA, ONT.—It is learned that the Burleigh Falls Power Company, of Peterboro, Ont., has purchased the Buckhorn Falls power outright. The falls furnish 2,000 horse power. The Burleigh Falls supply 5,000 horse power, and the company, of which Mr. Alex. Culverwell is president, has a deal on whereby a syndicate of New York capitalists has been formed and will establish a plant on a big scale to furnish power to Peterboro, Port Hope, Coburg, and other towns in Central Ontario. The Buckhorn Falls are situated about 18 miles from Peterboro.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The franchise for an electric street railway line in Stockton, Calif., was recently sold to H. H. Griffith, the original applicant.

SAN FRANCISCO, CALIF.—It is reported that within a short time an electric railway will be commenced from San Diego to National City. John D. Spreckels, who controls the electric railway line in San Diego, is behind the new enterprise.

SAN FRANCISCO, CALIF.—The San Francisco, Oakland & San Jose Railway Company, which has been incorporated in Oakland, Calif., with capital stock of $5,000,000, by F. M. Smith, F. C. Havens and others, will take the place of the San Francisco & Piedmont and the Oakland & San Jose Railway companies. The new company purposes constructing a tunnel from Goat Island to Oakland. An electric railroad will extend through Emeryville, Piedmont and Haywards. There will be an extension to San Jose. From San Jose there will be three branches, one to Los Gatos, 15 miles; one to Santa Clara, three miles, and one to Saratoga, 15 miles. The main line and branches will have a total length of about 93 miles..

HARTFORD, CONN.—The organization of the Willimantic & Southbridge Street Railway Company has been effected. Contracts for the construction of the road were authorized to be given out, for which bonds will be issued.

WASHINGTON, D. C.—The Washington, Baltimore & Annapolis Railway Company has given out the contracts for grading its electric line between Baltimore and Washington.

RUSHVILLE, IND.—Representatives of an Eastern syndicate have bought the complete right of way across the gas belt from this city to New Castle, Muncie and to Alexandria for a new electric road.

EVANSVILLE, IND.—The Evansville & Henderson Electric Railway Company has been incorporated with $10,000 capital. The directors are C. F. H. Lavell, of Evansville; C. C. Tennis and C. H. Battan, Cincinnati; and H. E. Randall, Dayton, O.

INDIANAPOLIS, IND.—The Richmond & Northwestern Electric Railway Company has been incorporated, with a capital stock of $50,000. Among the incorporators are G. M. Hodges, of Dayton, Onio; T. B. Millikan, of New Castle, Ind., and Milford Jesup, of Richmond.

INDIANAPOLIS, IND.—The Indianapolis Northern Traction Company has decided on the route for the proposed line to Logansport. The line will take in Noblesville, Tipton, Kokomo and Peru. A large substation will probably be erected at Carmel, between here and Noblesville.

NEW ORLEANS, LA.—The first interurban long-distance electric railway in the South will be built by Boston capital. It will be called the New Orleans and Southwestern Railroad. It will be 90 miles long, running from New Orleans through Hanlonville, Vacherie, Thibodeaux, Houma and other towns of the sugar district to a place on the Gulf coast where there is 18 feet of water.

WATERVILLE, ME.—A. F. Gerald, S. A. Nye and others of Fairfield are promoting an enterprise to build an electric railway between this city and Oakland.

PORTLAND, ME.—The White Mountain Paper Company has bought all the stock of the Fryeburg Street Railway Company, and purposes to construct an electric road to Stowe, Lovell and Chatham, N. H. E. E. Hastings, of Fryeburg, is clerk and treasurer of the new company. The directors are George B. James, Boston; A. C. Kennett, Conway; Col. E. C. Farrington, Augusta; E. E. Hastings and Henry Andrews, Fryeburg.

GREAT BARRINGTON, MASS.—The capital stock of the Berkshire (Mass.) Street Railway has been increased from $200,000 to $750,000, to complete the main line from Cheshire to Great Barrington and to build extensions in Pittsfield.

WORCESTER, MASS.—The Consolidated Street Railway Company has placed an order for four 300 hp water tube boilers with the Aultman-Taylor Company to replace a portion of the battery at the Worcester station. The price is about $20,000. The company has also placed a $60,000 order with the General Electric Company for 25 new closed cars.

PITTSFIELD, MASS.—A controlling interest in the stock of the Hoosac Valley Electric Railway, of North Adams, has been purchased by a syndicate, the members of which are stockholders of the Pittsfield Electric Street Railway. This purchase will bring about a consolidation of these two railways and there will be a continuous route from Pittsfield to Adams, North Adams and Williamstown.

UTICA, N. Y.—The double track trolley line from this city to Frankfort, ten miles to the east, was opened on June 14. This makes a through line from Herkimer to Utica. In ten days the line will be opened to Rome, and in about three months from Herkimer to Little Falls.

MASSILLON, OHIO.—The Massillon, Dalton & Wooster Railway Company ahs secured a 25-year franchise in Stark County.

CANTON, OHIO.—John Monett, of Canton, is promoting an electric railway touching Sandyville, Bolivar, Zoar and Dover.

LIMA, OHIO.—The Lima, Delphos, Van Wert & Ft. Wayne Traction Company has been granted a franchise to build its line into the center of Lima.

CLEVELAND, OHIO.—The Clevelaand, Elyria & Western Railway Company regular semi-annual dividend of two and one half per cent. on preferred stock on July 1.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway Company will allot pro rata among present stockholders $100,000 worth of stock which has been held in the treasury.

MT. VERNON, OHIO.—Fred Jones of this place is securing right of way and making surveys for a line from Mt. Vernon to Johnstown. The road would connect with the line from that place to Columbus.

CLEVELAND, OHIO.—Directors of the recently organized Cincinnati, Dayton & Toledo Traction Company have elected officers as follows: M. J. Mandelbaum, president; Will Christy, first vice-president; O. V. Parrish, Hamilton, O., second vice-president; F. T. Pomeroy, treasurer, and H. C. Lang, secretary.

CANTON, OHIO.—The Canton-Akron Railway Company and the Canton-Massillon Railway Company were merged on June 17 under the name of the former company. The capital stock will be increased from $600,000 to $1,600,000. The L. E. Myers Construction Company has been given the contract for building the extension from Navarre to New Philadelphia.

COLUMBUS, OHIO.—From reliable information it is learned that A. E. Appleyard of Boston, representing Tucker & Anthony of Boston, has purchased the Newark (O.) Traction Company line and the Interurban to Granville for the Columbus, Buckeye, Lake & Newark Traction Company. The price paid was several hundred thousand dollars. The road will be extended to Zanesville.

CLEVELAND, OHIO.—The Dayton & Northern Traction Company has given a contract to E. P. Roberts & Company, of Cleveland, for the engineering work for an extension of the road from Greenville to Muncie, Ind., by way of Union City and Winchester, a distance of 46 miles. When this is completed there will be a through line from Cincinnati to Ft. Wayne, Ind., as the Muncie, Hartford & Ft. Wayne Railway is now under construction. Plans are being prepared and actual construction work will start this fall.

PITTSBURG, PA.—The stockholders of the United Traction Company have ratified the action of the directors in the leasing of the Pittsburg & Charleroi Street Railway. The United Traction Company will pay a rental of $35,000 per year.

SKIPPACK, PA.—A company has been formed to build a trolley line between Souderton and Trooper. The directors of the company include E. S. Moser, Collegeville; H. W. Reiff, Lederachville, B. W. Dambly, Dr. J. N. Hunsberger, Skippack; John R. Cassel, Philadelphia; William S. Schultz, Dr. George K. Meschter, Worcester; Rev. W. S. Anders and D. M. Anders, Fairview Village.

DALLAS, TEX.—The Council has passed the Bonta franchise for the proposed Metropolitan Street Railway system. The franchise is estimated to involve an expenditure of over one million dollars in new construction. Mr. Bonta represents the United Electric Securities Company of Boston.

SHEBOYGAN, WIS.—The street car lines in the city have been practically tied up, due to a strike of the motormen and conductors who demand more pay. The company is not in favor of an advance such as asked for and is hiring other help.

TORONTO, ONT.—The employees of the street railway company in this city struck work recently. The strike continued for three days and was settled by the company granting the demands of its employees. During the continuation of the strike there was some rioting and the troops were called out in order to quell the disturbance.

THE AUTOMOBILE.

AUTOMOBILES FOR ELECTRIC LIGHT TRIMMERS.—The Syracuse Lighting Company has given orders to the Century Motor Vehicle Company for electric automobiles to be used by the repair and supply men. They will be equipped with a luggage box to carry 200 pounds and will be of special construction.

LARGE AUTOMOBILE.—A large automobile has just been completed by the White Steam Wagon Co. of Indianapolis, for a St. Louis firm. It is said to have a carrying capacity of 12,000 pounds, has 35 horse-power, with 225 pounds steam pressure, and is 25 feet long and 8 feet wide. The wheels are furnished with 12-inch tires. It is claimed that this is the largest automobile in the world.

NEW INDUSTRIAL COMPANIES.

THE OREGON ELECTRICAL ASSOCIATION, of Portland, has been incorporated, with a capital of $1,000. The incorporators are Ed. Cannon, R. W. Willbur and H. W. Hogue.

AN AMERICAN ELECTRIC SECURITIES COMPANY has been incorporated at Jersey City; capital, $300,000. Incorporators: Gustav Levy, A. H. Vanderpool and Martin Nathan.

THE ELECTRIC RAILWAY SIGNAL COMPANY, Kittery, Me., has been incorporated; capital, $100,000. President, W. M. Chapman, Newton, Mass.; treasurer, O. E. Chapman, Boston, Mass.

THE MACHINE ELECTRIC SUPPLY COMPANY has been organized in Indianapolis, Ind. The company will manufacture and repair electrical apparatus. The capital is $10,000. George A. Coldwell is chief promoter.

THE STATES ELECTRIC COMPANY, of Manhattan, New York City, has been incorporated to deal in electric supplies; capital, $1,000. Directors: Sarah A. Miner, Harry L. Stamper, and Jacob H. Lubin, New York.

THE ELECTRICAL SPECIALTIES COMPANY, of Jersey City, has been incorporated to manufacture electrical specialties; capital, $50,000. Incorporators: Horace S. Gould, John J. Billings and K. K. McLaren.

THE AMERICAN ELECTRIC IMPROVEMENT COMPANY, capital, $1,000,000, has been incorporated at Trenton, to manufacture electrical appliances. Incorporators: H. G. Bleakly, E. G. C. Bleakly and H. E. Stockwell.

THE NORTHERN ALUMINUM COMPANY, LTD., has been incorporated at Quebec with a capital of $500,000. The incorporators are Arthur V. Davis, of Pittsburg; F. A. Stoughton, G. G. Foster, Samuel G. Archibald and S. F. Belnap, of Montreal. The company has its buildings all erected and is already at work.

THE MULTIPLEX TELEGRAPH MANUFACTURING & EQUIPMENT COMPANY, of Jersey City, has been incorporated to manufacture telegraph appliances; capital, $100,000. Incorporators: W. E. Athearn, W. A. Van Orden, L. B. Foley, A. Kline, F. L. Blendinger, J. C. Willever, E. P. Griffith, Herbert Smith and Robert H. Morris.

THE PEERLESS COMPANY, of Warren, Ohio, has been incorporated with $500,000 capital stock to manufacture electrical supplies. Incorporators: T. H. Gilmer, E. W. Gilmer, Jacob B. Perkins, William Wallace, W. C. Ward, E. E. Nash, and J. W. Holloway. Several of the gentlemen mentioned are identified with the Warren Electric & Specialty Company, but the new enterprise is entirely distinct from the latter. It is stated that a large plant will be erected at Warren.

OBITUARY.

OBITUARY—Mrs. C. F. Brush, wife of Mr. Charles F. Brush, the eminent electricain and inventor, died in Cleveland on June 25 as the result of an attack of malarial fever.

PERSONAL.

MR. JOHN C. ROBERTSON, president of the Richmond Telephone Company, has resigned and has been succeeded by Mr. A. Maupin.

MR. WALTER MUELLER, of the staff of Mr. Ray D. Lillibridge, New York, was married at Trenton, N. J., June 21st, to Miss Meta Hepworth Thomas.

MR. W. J. PHELPS, of the Phelps Company, Detroit, Mich., was a New York visitor last week. He went to Philadelphia to attend the Telephone Convention this week.

MR. JAMES ROWLAND BIBBINS has resigned as assistant electrical engineer of the Detroit United Railway to accept a position in the Westinghouse Companies' Publishing Department, Pittsburg and New York.

MR. A. A. SER..., assistant sales manager of the Fort Wayne Electric Works, was in New York the early part of this week. He is visiting various branch offices throughout the country on behalf of his company.

MR. ELMER E. FARMER, the electrical engineer, has issued notice that the probate court of Berkshire County, Mass., has changed his name to Elmer E. F. Creighton, in accordance with the wish of his late maternal grandfather, David Creighton.

MR and MRS. A. M. YOUNG announce the wedding of their daughter, Miss Ella Shepardson Young, to Mr. John Henry Goss, on June 17, at the Anchorage, Pine Orchard, Conn. The happy pair are to make an extended tour and will be at home in Waterbury, Conn., next January.

MR. HUGH BONNER, ex-chief of the New York Fire Department, is now organizing the Manila Fire Department. He says the Philippine city is very combustible and that the growing use of electricity has added another fire peril to those which were already too numerous.

Trade Notes.

ASSIGNEE APPOINTED.—It is reported that the Sun Electric Manufacturing Company, of West Chester, Pa., has gone into the hands of an assignee.

THE DELAWARE HARD FIBRE CO., Wilmington, Del., is enlarging its plant to four times the present capacity. This indicates a large business.

THE ATLAS CEMENT CO., of Northampton, Pa., the largest cement works in the country, has just sent the Burt Mfg. Co., of Akron, Ohio, its fifth order for oil filters, making nine large Cross oil filters now in use in its different works.

THE BURT MFG. CO., of Akron, Ohio ,has recently made a large shipment of its oil filters to London, England. The question is suggested by the makers that if the Cross oil filter saves half on a manufacturer's oil bills, how long would it take it to pay for the Boer war?

THE READING GAS AND ELECTRIC FIXTURE COMPANY, Reading, Pa., describes and illustrates its complete lines of knife switches, panel boards, switchboards and electrical specialties in a catalogue of recent issue. A complete price list of these various devices, in all sizes, is also given.

VERTICAL MILLING MACHINES.—Catalogue No. 3 of the Garvin Machine Company, New York, is on the subject of vertical milling machines, profilers and duplex milling machines. Various styles of these machines are illustrated, each illustration being accompanied by appropriate descriptive matter.

THE W. S. HILL ELECTRIC COMPANY, New Bedford, Mass., reports that the call for switches arranged for enclosed fuses has become so general that it now carries all its standard switches in stock arranged for this type of fuse, when only a few months ago the open link fuse was practically the only one thought of.

JEFFREY SCREENS.—The Jeffrey Manufacturing Company, Columbus, Ohio, has issued a very artistic 48-page pamphlet devoted entirely to the subject of screening machinery for coal, ores, sand, carbon, graphite and many other materials. The half-tone illustrations are printed in a dark brown ink, which greatly adds to the artistic effect.

ELECTRIC FANS.—Green is the dominant color of a neat pamphlet on electric motor fans issued by the Electrical Material Company, No. 221 North Calvert street, Baltimore, Md. Fans of all styles are illustrated, price lists of the various sizes and finishes of each style being given. The catalogue is printed in green and it has a greenish cover.

TIES AND RAILS.—A few days ago the Maltby Lumber Company, Bay City, Mich., sent out a full trainload of cedar ties to the street railway at Des Moines, Ia., and the same company has just made another large shipment of poles to Arkansas points. This shipment was handled in the same manner as the tie train, the whole train being kept intact throughout the run.

"HY-LO" HANDSHAKE.—Mr. W. J. Phelps, of Detroit, has been a frequent visitor to New York in the past ten days. Last week he brought his famous Convention-"Hy-lo" handshake from Cincinnati to New York and then, to emphasize this new departure in courtesy, he revisited New York the early part of this week. Mr. Phelps's method of greeting prospective buyers and some others is becoming as famous as his 16x1 incandescent lamp.

THE STERLING ELECTRICAL MFG. CO., Warren, Ohio, makers of the Sterling special lamp, has recently been distributing a very attractive aluminum ash tray containing the name of the lamp and the address of the company in embossed letters on the bed of the tray with a very fine illustration of the lamp itself. The slogan of the company, "equal light," appears as a caption for the cut. It makes a very neat desk ornament apart from its utility.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is just issuing its new general supply catalogue, No. 16, and has in press a general telephone and supply catalogue, No. 17, both of which are hereafter to be issued annually. The price lists accompanying the catalogues are so arranged that leaves may be inserted in place of out-of-date ones. Thus customers will be supplied with catalogues brought up to date from year to year and with price lists that are always correct.

ADIRONDACKS.—The lakes and streams in the Adirondack Mountains are full of fish; the woods are inviting, the air is filled with health, and the nights are cool and restful. If you visit this region once, you will go there again. An answer to almost any question in regard to the Adirondacks will be found in No. 20 of the "Four-Track Series," "The Adirondacks and How to Reach Them;" sent free on receipt of a two-cent stamp, by George H. Daniels, general passenger agent, Grand Central Station, New York.

MOTOR-DRIVEN AIR COMPRESSORS.—The line of electrically operated stationary and portable air compressors manufactured by the Christensen Engineering Company, Milwaukee, Wis., is described and illustrated in Catalogue No. 51, just issued by the company. The important parts of the compressors are separately illustrated, and tables give the dimensions, capacities and other data relating to the various sizes and styles of these machines. The catalogue contains interesting information on the general subject, and is artistically gotten up.

WESTON INSTRUMENTS.—Mr. J. P. Brown, 136 Liberty Street, New York, selling agent for the Weston Electrical Instrument Company, has issued an addition to the 1901 edition of the pocket price list of Weston instruments. The list includes switchboard and portable instruments, also the R. & T. combination volt-ammeters. The latter instruments are designed for use in situations where extreme vibration is met with, or where water or dampness is likely to affect the working of an instrument, the operative parts being fully protected by a waterproof aluminum case.

THE FERRACUTE MACHINE COMPANY, Bridgeton, N. J., has recently shipped coining machinery to Birmingham, England, where is located one of the largest coining firms in England, all the coinage for the British Government being done by private corporations under contract. Among other recent shipments of coining machinery may be mentioned the following: to the English Government in British India, the Bolivian government and the Peruvian government. The shipment to the Bolivian government includes a complete electric plant to be used in connection with the coining machinery, as well as for lighting and furnishing power to be used for other purposes.

THE BAIRD MANUFACTURING CO., Chicago, Ill., has for some time past been engaged in developing a rapid-service, single-coin machine and also a rapid-service meter for telephone lines, which promises to be successful. Feeling the need of an expert in switchboard and line conditions, the company has been fortunate to secure the services of Mr. David S. Hulfish, who until June 1 was switchboard engineer of the Central Union Telephone Co. Mr. Hulfish assumed the office of secretary and electrical engineer of the Baird Manufacturing Company on June 1 and has already designed some great improvements for the new rapid-service machines which insure complete success. The new machine is almost ready for the market and will shortly be placed before Bell telephone licensees.

CORRESPONDENCE SCHOOL GRADUATES.—Among the recent graduates of the American School of Correspondence, Boston, Mass., were Frank B. Fuller, of Swampscott, Mass., who completed the marine engineering course in sixteen months, and Ray O. Caukin, of Jackson, Cal., who completed the electrical engineering course in the same time. Mr. Fuller is employed by the Boston & Maine Railroad Company, and Mr. Caukin by the Standard Electric Company of California. The record of another graduate, Mathias Knopf, of Newark, N. J., who completed the stationary engineering course while working as a fireman, shows what an ambitious man can do when he determines to gain a technical education. At the time he enrolled Mr. Knopf was not at all familiar with the English language. This delayed him somewhat on the earlier papers, yet he made better progress than many students not handicapped in this way. J. A. Gon-

stead, an engineer in the Minneapolis (Minn.) fire department, devoted spare time to the electrical engineering course, and completed it, also a course in mechanical drawing, in sixteen months. Another recent graduate in electrical engineering was George E. Higgins, superintendent of the Montreal agency of the Bell Telephone Company. Among foreign students who recently received their diplomas were Frank W. Burford, Timaru, N. Z., and Arthur E. Moss, Port Chambers, N. Z. It is interesting to note that the average of these men when they became students in the American School was thirty years, the youngest being twenty-three and the oldest thirty-five, and that they were regularly employed in some trade or profession while pursuing their studies.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED June 17, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

702,392. CIRCUIT AND CUT OUT FOR ELECTRIC ARC LAMPS; M. H. Baker, Newark, N. J. App. filed June 10, 1901. For preventing excessive tension in the lamp circuit at the starting of the lamp, a low resistance starting circuit having an inductive restraining device applied to it, is used. The starting circuit is cut out when the lamp begins to burn.

702,403. VALISE, HAND-BAG OR SUIT CASE; S. D. Chapman, Kansas City, Mo. App. filed April 7, 1902. A bulls-eye light fixed in the end of a valise, is controlled by a circuit closer in the handle of the valise.

702,405. INCLOSED ARC LAMP; W. L. Cheney and G. R. Davison, Newark and E. W. Skinner, Arlington, N. J. App. filed Jan. 6, 1902. To create a mingling of the gases of combustion with the outer air, a tube extends from a point above the gas check to a point adjacent to the arc and is open at both ends.

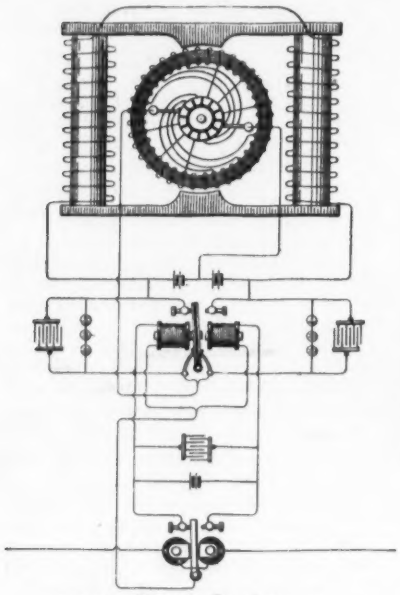
702,407. MOTOR GENERATOR; P. J. Collins, Scranton, Pa. App. filed Oct. 11, 1901. Several currents differing in character can be derived from the same machine and the electromotive force, frequency and volume of current can be readily regulated; the machine is intended for the use of physicians.

702,409. MULTIPLE SWITCH; H. H. Cutler, Milwaukee, Wis. App filed April 17, 1901. Multiple switches are arranged so that they can be closed only in a definite order and opened automatically at a desired time.

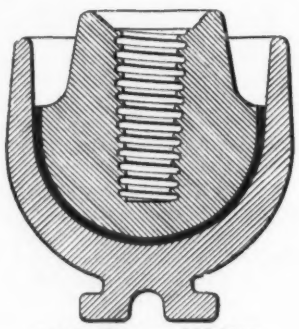
702,427. ELECTRIC RAILWAY; J. C. Henry, Denver, Colo. App. filed April 1, 1901. In a multiple unit system the step by step controllers are each operated by a solenoid and all solenoids are connected in series in a local circuit which is manipulated by a hand switch.

702,437. ELECTRIC CIGAR LIGHTER; W. F. Kessler, Auburn, Ind. App. filed Oct. 27, 1900. Details.

702,452. ELECTRIC SYNCHRONOUS APPARATUS; W. M. Miner, Plainfield, N. J. App. filed July 25, 1901. The vibrator which creates reversals of current to establish synchronism, is so connected with two batteries that their voltage cannot combine to establish an arc directly across the space from one vibrator contact to the other.



702,453. Electric Synchronous Apparatus.



702,660, Process of Making Insulators.

702,453. ELECTRIC SYNCHRONOUS APPARATUS; W. M. Miner, Plainfield, N. J. App. filed July 25, 1901. The object is to simplify the apparof the vibrator, a shunt for a source of current around the vibrator magnets is opened and closed by the synchronizing relay.

702,454. ELECTRIC SYNCHRONOUS APPARATUS; W. M. Miner, Plainfield, N. J. App. filed July 25, 1901. Theh object is to simplify the apparatus heretofore employed for keeping a motor running in synchronism with a distant machine; to diminish the number of separate generators which it is necessary to employ, to permit the use of motors having a large torque and operated by a heavy current.

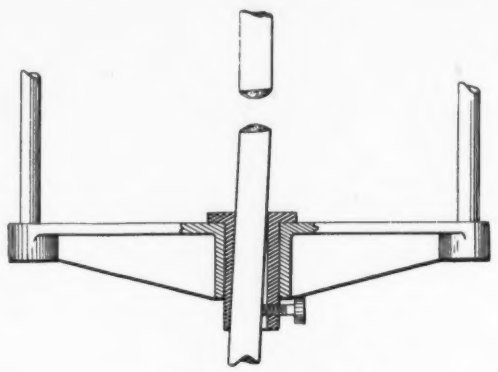
702,500. WATCH DEMAGNETIZER; P. Sorensen, Brooklyn, N. Y. App. filed Jan. 9, 1902. A crank handle by which the magnet is rotated, is provided with a circuit closer which automatically opens the circuit when the hand is removed.

702,514. CARBON HOLDER; S. B. Whinery, Pittsburg, Pa. App. filed March 18, 1902. The lower carbon holder can be rotated in a socket for the purpose of aligning the carbon.

702,544. ELECTRIC BATTERY; P. DeLafon, Paris, France. App. filed April 3, 1900. A carbon-zinc battery of the dry type.

702,599. COLLECTOR RING FOR ELECTRICAL MACHINES; R. Siegfried, Pittsburg, Pa. App. filed Feb. 1, 1902. The collector rings have offset arms with cylindrical bosses at their extremities which can be arranged axially in line with each other to be secured together by a single bolt.

702,622. ELECTRIC TELEGRAPHY; S. G. Brown, Putney, England. App. filed Nov. 5, 1900. The receiving apparatus can be arranged to overcome the effect of "overlapping" signals by neutralizing the effect of the last part of each signal upon the receiver.



702,514, Carbon Holder.

702,656. BLOCK SIGNAL SYSTEM; P. O. Keilholtz, Baltimore, Md. App. filed March 6, 1902. A signal is given in a cab of the locomotive when it approaches within a predetermined distance of another train on the same track.

702,660. PROCESS OF MAKING INSULATORS; F. M. Locke, Victor, N. Y. App. filed March 12, 1902. The insulator is built up of shell secured together by applying liquid glaze between the parts and firing.

702,661. INSULATOR AND PROCESS OF MANUFACTURING SAME; F. M. Locke, Victor, N. Y. App. filed April 19, 1902. A modification of the preceding patent in which the molten glaze is applied to the shells after they are nested together and allowed to cool.

702,662. CONDUIT FOR ELECTRIC WIRES OR CABLES; R. W. Lyle, Perth Amboy, N. J. App. filed April 10, 1902. Details of the joint.

702,663. CONDUIT FOR ELECTRIC WIRES OR CABLES; R. W. Lyle, Perth Amboy, N. J. App. filed April 10, 1902. Spring clips enter grooves on the exterior of the conduit as the joint to hold the sections in line.

702,666. ELECTRIC CLOCK SYNCHRONIZER; C. F. Mears, Silver City, Iowa. App. filed May 16, 1901. Details.

702,695. SPARKING DEVICE; D. M. Bliss, Brookline, Mass. App. filed Nov. 7, 1901. An artificial load is introduced into the circuit when the spark gap is open, the introduction being controlled by the opening and closing of the gap.

702,725. ELECTRIC CONDUCTING WIRE; H. Hammesfahr and E. Hammesfahr, New York, N. Y. App. filed Feb. 23, 1902. The insulation is braided spun glass.

702,734. ELECTRIC WATER RECORDING DEVICE; W. H. Kelly and A. Tschinkel, New York, N. Y. App. filed March 15, 1901. Details.

702,751. TRANSMITTER; A. Von Wagenen, Sioux City, Iowa. App. filed March 27, 1901. An index is moved to the desired point on the dial and a push button then forced inward to send the signal.

702,752. ELECTROSURGICAL INSTRUMENT; R. H. Wappler, New York, N. Y. App. filed June 10, 1901. An arrangement of tubes in connection with an incandescent lamp for exploring certain organs of the body.

702,758. METHOD OF GRAPHITIZING ELECTRODES; E. G. Acheson, Buffalo, N.Y. App. filed Dec. 12. 1900. (See page 1155.)

702,760. ELECTROCHEMICAL GENERATOR; H. S. Amwake, Camden, N. J. App. filed March 13, 1902. A baffle plate is inserted between the electrodes of the cell to create a devious circulation of the electrolyte and prevent undue heating and consequent increase of resistance.

702,808. ELECTRIC PROGRAM CLOCK; J. O. Lyman, Waterbury, Conn. App. filed Aug. 16, 1901. Details of a circuit closing apparatus.

Supplement to ELECTRICAL WORLD AND ENGINEER, *June 28, 1902.*

Sixth Annual Convention of the Independent Telephone Association of the United States.

THE sixth annual convention of the Independent Telephone Association of the United States was held on June 24, 25 and 26 at the Hotel Walton, Philadelphia, the meeting being called to order by President Thomas in the large ballroom at the top of the hotel. It had been supposed by some that the recent interstate meeting at Chicago would interfere with the attendance, but as a matter of fact this was not the case, the record number of 350 names being registered by Wednesday morning.

The address of welcome was delivered by Mayor Ashbridge, who defended his action in favoring independent telephony in Philadelphia and said: "I am a great believer in competition in all things, and in that belief, I signed the so-called 'Keystone Telephone Bill,' for which, in the parlance of the railroad man, I have had the 'red board' against me ever since. But it matters but little, if one feels that he is doing his duty and is benefitting the community, in giving better service, at cheaper rates; and anything that will materially benefit a community or a people or a business, I count it the duty of those in authority to carry out and execute. I, therefore, have no apologies to express, for signing a bill, giving to the people of this city a franchise, through a company that has become such a factor in the commercial life of the city.

"Telephones are no longer experimental, but are practically useful things that enter into the daily life of all people, in all conditions of life—the physician and the lawyer, the merchant and the manufacturer; and into the home life—our domestic world—it enters so largely, that we welcome all competition that has a tendency to extend its usefulness. I am glad, to-day, to be here to welcome you—men of the independent telephone business—who have had the moral courage and the intellectual development to chance your money in investments in a business in competition with a great monopoly.

"We are glad, indeed—let me repeat—to have you here in our midst, that you may commune and exchange thoughts and ideas with those connected with our organizations in this city, whether it be in telephony or other directions, and so increase the commercial benefit and the manufacturing genius of our nation. You are to be commended for your moral courage in entering into competition with what was one of the great monopolies and held this country by the throat, so that no one else dared to enter into the territory forbidden by its edicts. 'In union there is strength,' and by your combination and organization you have been able to successfully combat those people who tried to crush you out of existence. I am not antagonistic to the Bell company; on the other hand, I have warm personal relations with many of the officers of the company whom I esteem very highly as men. But this country is too great, and the interests of its people are too great for one man, or one interest or one concern, to monopolize all the good things."

Hon. S. P. Sheerin, of Indianapolis, on behalf of the Association, returned its thanks to the mayor for the welcome extended, and said that the Association represented the American average in most things, and rather more than the average in fighting qualities. They were anti-monopolists, and with them it was not merely a principle, but a business and a pursuit. Hence it was natural they should visit the "cradle of liberty" at least once for an inspiration.

Judge Thomas then delivered his annual presidential address, discussing chiefly the financial aspects of independent telephony. he said:

"In the Annual Report of the President of the American Telephone and Telegraph Company, under date of December 31, 1901, page 8, we find the following:

"Competition from telephone companies not associated with this company has existed for several years and is likely to continue in some places for some time to come. While it has in some places affected the licensees of this company disadvantageously, by reducing, for a time at least, the number of their subscribers and forcing them to meet competitive rates that are not based upon a proper recognition of the cost of doing business or an adequate appreciation of the amount that should be set aside from earnings for maintenance, reconstruction and depreciation, the consequences of the competition to the business as a whole, have not been of serious moment. The public in each community will determine for itself whether it is for its advantage that there should be two telephone exchanges serving one body of people. It would seem as if but one conclusion on this point was possible." We believe a little closer examination of the subject would have caused the report to say that these low rates are made in the hope of destroying competition. In almost every instance instead of meeting competitive rates they have offered ruinous rates, and so far have failed to destroy competition. So that the public so far has not determined whether there shall be two exchanges, except in some instances where the patronage has been withdrawn from the Bell exchange and the same has been closed. The public desires that competition exist in all lines of business, but we do not believe in ruinous competitive rates. And we do not believe as a general rule independent rates, as they have been established by the majority of companies, are too low. On the other hand, they show good business profit.

"We agree with Mr. Fish's statements that 'Competition has existed for several years and is likely to continue in some places for some time to come and has affected the licensee companies disadvantageously.' We also agree with his statement that the consequences of competition to the business as a whole have not been of serious moment. On the other hand we believe most sincerely that competition has done more for the telephone business than was accomplished in the entire period before competition entered the field, and cite you as a proof of that fact the last annual report of the president of the American Telephone and Telegraph Company. The growth of the business since that time has been marvelous, while the character of service has been greatly improved.

"Our object in this address shall be to frankly, fairly and broadly present the telephone business as it exists to-day, to insist upon rights, to discover wrongs, and, if possible, to be of some service to the many interests throughout the country; to point out a way of eliminating dangers to capital, which come through mistaken promotion and ruinous rates. We know that capital is needed to carry on this great enterprise which has been given such great impetus through competition. We desire to assure capital that with proper precautions there is no safer investment. We shall therefore begin with rules governing real estate investments and try to apply them to this business as a guide to safe, permanent investment." Judge Thomas then made an analogy or comparison with the work of the architect and builder, and continued as follows:

"The building of telephone properties has not been known to man very many years. It is fast passing out of the pioneer stage. though no telephone property has ever yet been completed. But now men who are giving close study to this great and important business believe that the time has come when we should look to the essentials, from the investment standpoint. This business requires more capital than is to-day at the command of the people who are at work in the building up of telephone properties, a stage that is always reached in the building up of great enterprises. Like all who work in a common business, we should in view of this fact, give earnest consideration to the best means of relieving the situation. We have in our meeting to-day enough men to invest during the present year more than was invested the first ten years of the use of the telephone. Local telephone investments are at present limited to the influence of the crowd which undertakes the enterprise, retarded by all other influences that are seeking money for investment in other enterprises, plus the influence of the Bell Company working through many of the financial institutions of the country.

"The general money markets have not yet been opened up to the business. Large enterprises have been compelled to pay heavy tribute to the underwriter. There are some instances where the underwriters' profits have very greatly embarrassed the enterprise, and others where this is sure to come in time.

If we have reached the period of building permanent investments, which we believe we have, then we must consider the best ways and means of building so as to be attractive to capital. Surely, no one who has studied the subject will deny that the prospect for the use of the telephone in the future is greater than it has been in the past; that the demand for its use exceeds the ability of the companies to supply it. The thing itself is necessary to the present methods of social and business economy. When men no longer talk, then the telephone will be placed in museums with the mummy and other dead things.

"If the thing itself is of a permanent nature, like good building ground, by employing the proper agent, architect, builder and operator, the telephone investor will have a desirable, permanent investment, such as is not only sought in local, but general money markets. The capitalist is always ready to invest in something sure and permanent, even though the returns are not very large. This being true, then somewhere in this field of investment there is something wrong, or else we could reach the money centers as well as local financial resources.

"The telephone was a mere toy and plaything at first, something that was novel and entertaining. The original investors did not risk very much. They used the usual methods of convincing the inventor that there was very little value to the thing, and he, in order to make some money, must sell cheap; they would take all the risk of perfecting and placing the thing in public use because they loved him so. That was in the days when men were selfish, before the millennium had dawned.

"Some very selfish contracts were made which aimed to be perpetual and exclusive. Through all the different stages of the growth of the American 'Bell' organization and the preceding organizations, we find the work of the skillful hand of monopoly. These contracts demand unreasonable tribute to the small capital which represented the parent company. It was the working out of a scheme which demanded for a small number of people with a small amount of capital unreasonable tribute from a large number of people representing a large amount of capital. In other words the very small amount of capital employed in purchasing the invention and bringing it to perfection was to always receive reward from the people themselves through these contracts after the right, under our patent laws, had expired—by always compelling the hundreds of millions of dollars invested in the manufacture of telephones and switchboards and the building of exchanges and systems throughout the land, to pay a royalty or rental. This is clearly against the principles of our moral and civil laws and cannot be justified and must fail in its purpose. We find here, perhaps, the greatest cause for the failure of capital to invest in this field so rapidly as it should.

"Broad minded men are at work on the solution of this problem and everything necessary to give to the people telephone service at a fair price and give adequate reward to capital and labor will soon be solved. The price through competition having in most instances been reduced to the minimum, something must be done to preserve the capital already invested and induce new capital to come into the enterprise.

"People should never uphold ruinous competition in anything any more than they should uphold ruinous monopoly. We must always be fair and just to both sides of a controversy. The user of the telephone must not be allowed to enjoy its great privileges at the expense of the man who has invested his money. We only want such competition as will cause the capitalist to be fair; and not a competition that will give advantage to the user.

"If the people are to be given the benefit of reasonable rates, and the capitalist of a fair return on his investment, the individual, the municipal, county and State organizations must not be selfish and unfair. The present tendency to hold the corporation up does not benefit the people, and is not pleasing to capital, and is a dangerous weed which seems just now to flourish. The public official should be confined to the reward contracted for when he agreed to accept its trust, and should have no superior right over his neighbor in dealing with corporations. Franchises and rights-of-way should be granted on fair and equitable lines and should be considered in accordance with the great benefit the new enterprise will bring the community. The telephone should always be considered as one of the most beneficial enterprises and should under proper police restrictions be welcomed to a city, county or State, without burdens which will affect the rights of the user or the capitalist. The United States, in consideration of its general usefulness, should do everything necessary to reduce the obstacles in the way of establishing full, complete service at reasonable prices. It should do more, perhaps, than to remove obstacles; but that we will not consider.

"We find upon a careful study of this proposition many difficulties. We believe no other business presents quite as many. We find throughout the slow stages of development a long period of pioneering that has cost a great deal of money, which practically has had to be replaced by installing more efficient apparatus and construction every few years. So that the capital invested has grown to very large proportions; where much more capital is necessary to be placed in the business in order to take care of the demand for service within the next year or so.

"While this, on first thought, seems discouraging to the promoter, we must remember that the same is true of every business of a general nature that has had to be developed through invention. We should bear in mind that through this pioneering we have educated the people to use the telephone, and that they are educated for all time in this method of communication. That while this has been accomplished, we have also been educating persons to handle the business more economically; while the inventors are constantly giving us new facilities for more economically handling the business. There is no excuse now for poor construction, inferior apparatus, ruinous rates, over-capitalization, incompetent employees, or any other thing that would bring danger to the investor. All we now need is to frankly confess our errors in the past, and proceed as business men in all lines proceed, to properly take care of the capital invested in the business, using modern methods and economies in working out the plan. Let us recognize one another's rights, and work in harmony to one common end, to place the business upon a firm financial footing.

"The Independent Telephone Association has from its birth taken a stand of recognizing every man's rights. And the work of the officers and committees of the association has always been free from preference or prejudice, and has been conducted upon broad and just principles. The banner of this association has never been trailed in the dust."

Judge Thomas then quoted in full with approval an editorial on the association meeting in ELECTRICAL WORLD AND ENGINEER, of June 14 as appropriate to be read on the occasion, and closed as follows: "We feel that on account of the standing that this association has gained as the representative of the independent telephone companies of the United States, that it must be the advanced thinker and the advanced worker in this field; that its policy should be ever onward to work out difficult telephone propositions on lines that will be both pleasing to capital and to the people. That its objects should not be to destroy, but to build up. That it should not be governed by prejudice or preference, but by justice and fair dealing. We hope and believe that this will be its future course."

After a little formal business the convention then adjourned till Wednesday at 10 A. M.

WEDNESDAY SESSION.

At the opening of the Wednesday morning session, Prof. W. E. Goldsborough, of Purdue University, Lafayette, Ind., on behalf of the Business Men's League of St. Louis and of the Exposition authorities, invited the Association to assist in making the Exposition a success and to enjoy the hospitalities of the city. He made a strong and effective statement as to the scope and opportunities of the St. Louis Fair in 1904, especially on its electrical side and in regard to the duty of all telephone men to educate the public up to the larger and fullest possible use of their apparatus. As to electricity, he stated that while 5,000 hp had been adequate at the beautiful Pan-American in Buffalo, St. Louis would need 25,000 to 40,000 hp of current. Electricity Building would be not less than 600 feet square, and architecturally one of the most imposing structures on the grounds.

Mr. Hugh Dougherty, of Bluffton, Ind., offered a resolution heartily favoring the support of the Exposition by the Association.

One of the manufacturers present opposed going to St. Louis,

in view of the poor results that had attended the meetings at the Pan-American, but after it had been pointed out that the resolution did not include fixing a convention in St. Louis, the resolution was adopted unanimously.

Mr. Lewis A Goudy, president and general manager of the Northeastern Telephone Company, of Portland, Me., read a paper on "The Telephone Situation in the Northeast." He stated that in the New England States a very small percentage of the people were subscribers to the telephone. In Maine less than one and one half per cent. were subscribers, and the proportion was even less in New Hampshire and Vermont. He held this to be due to the policy of the Bell Telephone Company in demanding high rates. This was now changing, on account of the movement fostered by the Dirigo Telephone Company of Maine, which had since become the Northeastern, although the Eastern Telephone Company of Portland had become associated with Bell interests. The Northeastern was therefore the only absolutely independent long distance competitive company in the territory, with liberal State charters for both Maine and New Hampshire, and owning trunk lines connecting between 60 and 70 exchanges and toll stations, with 200 miles of pole line construction terminating at present in Portland. "The Northeastern Company owns and controls the secret automatic system for the Northeast and has perfected its plans for the installation of that system in several cities in Maine and New Hampshire." The company has nearly 1,000 subscribers actual and immediately prospective, and Bangor, Skowhegan, Waterville, Augusta, Hallowell, Brunswick and Westbrook were all asking for competitive service. In substantially all these towns, licenses had been secured, and virtually capital was the only requirement for strong opposition. They would use the Strowger system for the larger exchanges in conjunction with the manual party line service for long distance connections and smaller exchanges, for which they had successfully tested a selective party line device making every line a private line.

Mr. Goudy then went on to refer to some of the incidents that had made independent work difficult in Maine, and referred to the law against common use of routes already occupied by one party unless consent were first obtained from the prior company or firm. He proceeded to indulge in some rather strong language as to the "devilish methods that have been used by the agents of the monopoly company, high and low, to defeat and destroy the possibility of competition;" and he referred darkly to proof which he had in his possession that would convince the most skeptical as to the debauchery of public men by which the great monopoly had entrenched itself in the East. He then proceeded to discuss the lowness of early Bell telephone rates in the Northeast, for example, as compared with the later ones prevalent, except where competition prevailed. In the city of Portland under the influence of competition, the New England Bell Company had, after installing its central energy system, advertised free telephones for several months, provided the subscriber would contract for a term of years at standard rates—to new subscribers only. He claimed that the New England Company and the parent Bell were unduly and unnaturally watered and inflated; hence the rates. The first capitalization of the American Bell was $200,000, of which $50,000 was cash and $150,000 patent rights. Six months later, the Bell Telephone Company was incorporated with a capital of $450,000, of which $400,000 represented patent rights and $50,000 only cash. Six months thereafter the two companies, he said, were combined as the National Bell Telephone Company, capitalized at $850,000, of which $650,000 was for patent rights and only $10,000 cash; the balance, $190,000, was represented by apparatus in use. As to the New England Telephone & Telegraph Company, operating in Maine, New Hampshire, Vermont and Massachusetts, the last annual report of March, 1902, etc., showed the capitalization to be $20,000,000 gross, or with reserve, profit and loss, etc., total capital liability of $24,630,753. This is offset by assets of real estate, $54,612; cash and debts receivable, $2,534,971; material, merchandise and stock, $795,659; miscellaneous, $952,666; patents and franchises, $20,952,844; to which is to be added $10,000,000 new stock, making a total of $35,000,000, representing less than 100,000 telephones in the four New England States. But its earnings for 1901 from exchange service—leaving out tolls—were only $3,769,844; its expenses account outside of dividends paid was $4,139,929. In the items of expense was $254,238 rental and royalty charges to the parent American Bell Company. Such conditions were certainly favorable to new competition.

A paper was then read by Mr. E. E. Webster, of the same company, for Mr. C. H. Judson, of the Twin City Telephone Company of Minneapolis, Minn., on "The Telephone Situation in the Northwest." This paper reviewed familiar conditions in the territory named, chiefly as to Bell sub-licenses.

The discussion on these two interesting communications was rather slim as to new data, but excessively verbose; but Fisher, of Grand Rapids, alleged that similar methods were being pursued by the Bell people elsewhere, in Ohio and the middle west, as to entangling alliances, and that the Central Union Company sought to secure all the independent companies it could as to sub-licensees. Messrs. Webster and Critchfield contributed to the discussion on parallel lines, while Mr. Goudy returned to the charge by making a series of astounding statements, supported by documentary proof in bulky envelopes, or by broad inuendo, as to the utter want of honesty and principle of about every public man and every lawyer—save one—in the State of Maine when it came to fighting the New England Bell Company. He had with him lists of high officials enjoying telephone franks in Maine and presented altogether such a distressful picture of affairs in a Republican State, that Mr. Sheerin, who is well known as a Democratic leader in Indiana, felt compelled to offer sympathy and relief that could hardly be said to carry real balm. Mr. Sheerin, in regard to the sub-licensee question, urged reasons and data against taking a Bell franchise or license in any form, and cited cases in Indiana where it had worked out very unsatisfactorily for the independents concerned.

The meeting then adjourned to Thursday at 10 A. M.

THURSDAY MORNING'S SESSION.

At the opening of the Thursday morning session a brief but pungent address was made by Mr. Thomas Martindale, who was at the head of the movement which after some years climaxed in the establishment of independent telephony in Philadelphia. He expressed the hope and belief that a newspaper system on the Buda Pest plan would be developed by the country exchanges, so that the newspaper once or twice a week would be supplemented by daily news service to each subscriber. It was easy still to put up pole lines in the country, but he doubted whether in cities space could be found for many more conduits for telephones; certainly not in Philadelphia.

Hon. L. J. Hackney, of Indianapolis, then presented a paper read by Mr. Sheerin, "Where We Were and Where We Are," reviewing the history of the independent movement. He claimed that now the independent industry had the smallest bonded indebtedness of any branch of business in the country. As to tendencies in Indiana he mentioned the fact that Evansville was discussing a municipal telephone plant. He rather ridiculed the idea that long distance toll line connections were necessary to independent success, and said that in Indiana only two and one-half per cent. of the toll line business went out of the State, while 89 per cent. of the messages at any center of population keeps within a radius of 35 miles. There were now 70,000 independent telephones in Indiana, and at the best ratios prevailing, that number could be brought up to 412,000.

Mrs. Annie McE. Brett of the independent company at El Paso, Tex., and president of the Brett Construction Company, then gave a brief but very interesting account of her successful work in Texas. At El Paso she now had 1,550 three-year contracts, and she was engaged in developing other exchanges as well as in long line work.

Mr. L. W. Stanton, chief of equipment of the Federal Telephone Company of Cleveland, O., then read a valuable paper on the great technical problems. It is given elsewhere in this supplement. Mr. Stanton had several diagrams with which to illustrate his remarks, and in support of measured service arguments used in the curve of growth recently shown in ELECTRICAL WORLD AND ENGINEER as to New York.

Mr. Breen, contract agent of the Keystone Company, an old Bell man, disputed the measured rate idea, and pointed to 12,000 five-year contracts as an evidence that people wanted unlimited service.

Mr. C. E. Wells, of Marion, Kan., then presented a paper through Mr. J. B. Ware, of Detroit, on "The Telephone Situa-

tion in the West." The early Topeka plant was the only instance of independent failure he knew of in the State, and the movement had spread to every town down to 1,000 inhabitants, and even to those of four or five hundred. Lawrence and Kansas City were now coming in. The uniform success was remarkable. In Salina, there were now 560 subscribers, while the Bell people, even with free rates, had only some 30. The situation might be thus summed up: The Bell people outside Kansas City had perhaps half a dozen exchanges worthy the name, aggregating 4,000 subscribers, with 1,000 more at scattered points. The Kansas Independent Association, with some 60 companies, had in operation at last reports nearly 19,000 telephones, which was about 60 per cent. of the total in the whole State. As to long distance work, he then made incidental reference to the plans being carried through by Mr. Fred DeLand. Reference was also made to success in Oklahoma and Nebraska, and very emphatic endorsement was given to the good done by the Independent Telephone Association.

Prof. W. E. Goldsborough, of Purdue University, Lafayette, Ind., then gave a very interesting account of the special telephone course recently established there, the first in the country. He did not hesitate to express the opinion strongly held by himself, that many of the problems before the telephone engineer were more difficult to solve than those dealt with by engineers in the fields of light and power. As to the course itself, it had been laid out after careful consultation with the best men in the Bell and independent branches of the industry.

Hon. H. D. Critchfield, who was listed for a paper on "The Financial Status of the Independent Telephone Movement," begged off and was given permission to prepare it for the printed transactions.

Thanks were given to the Keystone Telephone Company and to others who had gone to great trouble and expense to make the visit of the association to Philadelphia enjoyable and memorable.

The meeting then adjourned, leaving election of officers for the afternoon, but not before passing unanimously the following resolution, presented by Mr. S. E. Wayland, of the Scranton Independent Telephone Company:

WHEREAS, it is generally believed and currently reported through the Press of the United States, and otherwise, that a combination exists among dealers in electrical supplies, the purpose and object of such combination among others being to unlawfully increase prices of such supplies from 25 to 50 per cent.; to limit the production of such material; to unlawfully discriminate in favor of certain purchasers of such supplies, and to boycott or cause to be boycotted buyers or dealers who are not affiliated with such association or combine; and

WHEREAS, such organization in effect amounts to a conspiracy which unlawfully and injuriously affects general trade in such supplies, and is especially injurious in its effects to purchasers of apparatus for Independent Telephone properties.

NOW, THEREFORE, BE IT RESOLVED, That the President and Secretary of this Association be and are hereby directed to advise the Attorney General of the United States of the nature and methods of doing business practiced by said organization or combine, and to request the Attorney General of the United States to cause an investigation to be made of the methods of said combination or association, and to tender the assistance of this Association, if desired, in making said investigation, and if found to be in violation of law to request the Attorney General of the United States to commence action and prosecute the same to a conclusion with a view of preventing and terminating such unlawful business methods.

AFTERNOON SESSION.

At the afternoon session the following ticket was elected unanimously: President, Jas. M. Thomas, Cleveland; First Vice-President, Hugh Dougherty, Bluffton, Ind; Second Vice-President, C. E. Stinson, Rochester, N. Y.; Third Vice-President, W. H. Durin, Cedar Rapids, Ia.; Secretary and Treasurer, J. B. Ware, Detroit, Mich.; First Assistant Secretary, C. E. Wilson, Philadelphia; Second Assistant Secretary, E. L. Barber, Wauseon, O.; Third Assistant Secretary, T. B. Lee, Pittsburg, Pa. The new Advisory Board is as follows: J. M. Thomas, S. P. Sheerin, H. Dougherty, H. D. Critchfield, E. B. Fisher, S. E. Wayland, W. B. Seaton, G. W. Beers, H. C. Young and E. E. Webster, the last two being the new members.

The convention then adjourned, in order to join in a trip given by the Keystone Telephone Company to all attending, to Atlantic City, for which a special train had been provided. This trip was of a specially attractive nature to many of the attendants from the West.

Needed Improvements in Independent Telephony.*

BY L. W. STANTON.

THERE are three giant problems: Tariff, Traffic and Equipment, which are deserving of as much sound consideration as any problem in the industrial field to-day. Public sentiment has been a very prominent factor in the independent field, but it is becoming more and more apparent that the company giving the best service and the most courteous treatment will secure the business.

The discriminating public have favored the home companies on account of their origin and the conditions under which they were brought into existence. This protection has extended over a number of years, but the time will arrive when the independent companies, even though they be owned locally, must demonstrate their ability to furnish as good or better service than their competitor. The writer is acquainted with several independent exchanges in which the service is inferior to that of the Bell Company, yet the public tolerate it, remembering the treatment they formerly received before the inauguration of the independent companies. This will not always exist. The public is prone to forget.

The company furnishing the best service to the greatest number at an equitable rate will, unquestionably, do the greater business. For the independent companies to bring about such conditions requires a far reaching revision in their present tariff system, a change in their engineering and equipment, and attention to details in traffic, the like of which they have never known before.

In our larger cities there are thousands of families and hundreds of small tradesmen that cannot afford to pay for flat rate individual service, neither can the telephone company, from a financial standpoint, afford to reduce its rate to meet these requirements. The inevitable result is party lines and measured service. He knew a great many are opposed to this class of service; some for reasons which are valid, and some for reasons which are thought to be valid, but which are not. There has been a great deal of prejudice against the party line, owing to poor apparatus and inferior traffic arrangements.

A great deal has been due to public sentiment, which is unjust to the telephone company and unjust to the subscriber who can not afford individual metallic service. By the use of the party line thousands of subscribers can be served that could not otherwise afford individual service. With a good system of four-party line selective, with the traffic details well worked out, this service for the small user is almost as good as individual service. You say that it works an injustice to the subscriber who has individual service. It is quite the reverse. It is optional with him whether he will use the party line or not, but in ninety-nine cases out of a hundred he is glad to have a chance to telephone to his party even though it be over a party line.

Let us now look into the financial aspects of the party line. We will assume the exchange from which we draw our figures to be one of 5,000 lines, built at an average cost of $100 per

COMPARATIVE DATA-PARTY LINE SERVICE—6,000 LINE EXCHANGE.

No. of Phones per Line.	Average Cost per Line	Rental per line per year	Cost to Operate per Line	Interest on Investment per Line	Depreciation 10 per cent. per Line	Total Cost Opr. Int. & Deprec. per Line	Net Earning per Line	Net Earning per Phone	Net per cent. Earned on Investments per Line.
1	$100	$48	$15	$5	$10	$30	$18	$18	$18
2	125	36-72	22.50	6.25	12.50	41.25	30.75	15.62	24 3/6+
4	175	27-108	37.50	8.75	17.50	63.75	44.25	11.06	25+
		24-96					32.25	8.03	18+
8	275	20-160	67.50	13.75	27.50	108.75	51.25	6.41	18.6
		18-144					35.25	4.40	13.—

line, and $25 extra for each additional party line telephone, including the phone, interior wiring, line drops, etc. We will

* Abstract.

assume the rate for individual service to be $48 per year; $15 per year for operating individual service telephones, and $7.50 per year to operate each additional party line telephone. Figuring interest at five per cent. and depreciation at ten per cent. on the amount invested, we find by referring to the chart that upon doubling the number of telephones on the line and decreasing the rate one-quarter we decrease the net revenue per telephone, and increase the net revenue per line; what is most noticeable is that the net per cent. earned on investment per line is greater for both two and four-party line than for either a greater or less number; a point that should not be lost sight of in establishing party line rates is that a dollar or two difference in the rate makes considerable difference in the net per cent earned on the amount invested as is shown by the two rates on the four and eight party lines; while the above table lays down no special rules to work by, it calls attention to facts that should not be lost sight of.

From the foregoing we see that the party line is a success from a financial standpoint, and a necessity from the view that the company serving the greatest number of people, renders a service the more valuable and will, therefore, secure the business, if the service is kept up to the standard.

We will now look at the party line from a traffic and tariff standpoint, which is an exceedingly complexed problem. There are three principal objections to the party line: First, the annoyance from the bells ringing when someone else is wanted, second, the frequent report of "line busy," third, service is not private. The first objection can be almost entirely eliminated on party lines of four or less, providing the equipment is of proper design and the operating is good. The second is a more difficult problem. If there are two or more parties on the line with unlimited service the line will frequently test "busy." To remedy this some form of measured service will be necessary. While it is admitted that measured service adds complications it is undoubtedly the most equitable method of charging. While there are several forms of measured service, there are none that entirely fill the requirements. Automatic apparatus either at the telephone or on the switchboard, is not satisfactory, for in the case the line called for should be busy there would be a call registered without the party securing the service. With either a meter or slot machine placed at the telephone it slows the service, for the operator must remain in on the line until the called for party is secured, and the calling party has registered or deposited the required coin. This also works a hardship on the party called for, as it is necessary to wait until the party calling deposits the coin or registers. The system of measured service where a meter is used is also more expensive, inasmuch as it requires a visit to each telephone to take the reading of the meter before a bill for service can be rendered.

The system in use in a number of the largest Bell exchanges and the one which gives the best general results is where the operator marks down the number of the telephone of the party calling, and in case the call is not completed she draws a line through that number. Each hour these sheets containing the record of the calls are collected and sent to the billing department.

Measured service handled in this way gives the subscriber very prompt and efficient service. This class of measured service used in connection with a four-party line will give excellent results. Suppose you allow each party line subscriber 600 or 1,000 outgoing calls per year on a four-party line or 1,200 to 1,500 on a two-party line, at a minimum charge with a fixed rate per message for all additional calls; all incoming calls free. Handled in this way the report "line busy" will be no more frequent than it is with individual unlimited service: in fact, the calls will probably average less per four-party line than with unlimited individual lines.

In a peg count which the writer examined where there were nearly 5,000 party line phones, all of which were either measured meter or nickel service, the average call per day, per telephone was 1.3.

In regard to secrecy or privacy of a properly designed party telephone, it is almost as private as an individual telephone. With a lamp signal board and selective ringing, the different parties on the line have no means of knowing when a party is calling or being called and if a line is in use they can readily hear another party come in on the line. With the three main objections just cited handled as above described, the party line gives a very desirable service and comes within the reach of a class of patrons or users that would otherwise be barred. From the foregoing it is plainly evident that the party line has a mission of importance to fulfill.

Up to the present time the call for the party line equipment has not been very great and the independent manufacturers who have done so well in furnishing equipment, have not given this subject the attention that it should receive in the future. One of the leading manufacturers is just placing on the market a four-party selective system which depends upon the number of frequencies to operate the bells. From the limited experiments the writer has had an opportunity to make, the system seems to possess valuable points over the pulsating bell type, which has been used by the Bell Company.

Before party line service can become thoroughly commercial among independent companies the manufacturers will have to revise their design of equipment. In the party line circuit of most of the manufacturers, either one or both sides of the line are permanently tied to the central battery, which is grounded. This makes four-party selective signaling very difficult ,if not impossible. While the independent companies are beginning to realize the value of the party line they need to equally realize the danger there is of very seriously impairing the efficiency of their present service. If inferior apparatus is used, or if the apparatus is not properly installed, or if the operating is not under proper discipline, the service will be such that the company will lose rather than gain by adopting party lines. One of the greatest needs of the independent telephone interests is either for this association or a kindred association to take up, in a technical way, the practical subjects of traffic engineering and equipment. The day for long distance telephony is just in its infancy, and for the independent companies to handle their share of the traffic and give the class of long distance service that will be demanded, they will be compelled to adopt a more standard form of equipment. The writer's experience on the United States Telephone Company's long distance lines is that where 20-volt to 40-volt common battery systems made by different manufacturers are connected the results are unsatisfactory. So much so in one case where a 40-volt system was installed, the former toll business at that place was almost lost for a period, owing to the inefficiency of the system for long distance work. Later a change was made that remedied the condition to some extent, but the system has never given the service it should. The trouble just cited was not due to the fact that it was a 40-volt system, which voltage is probably nearer correct, but due to the fact that the system was improperly designed, for receiving incoming toll business.

The above well illustrates why telephone apparatus should be standard. From the output on the various independent manufactures there could be selected a line of high class apparatus that would be worthy of standardization.

Attendants.

The following is a list of those registered as present from operating telephone companies:

HAVERHILL, MASS.—People's Tel. Co., N. N. Spofford.

JOHNSTOWN, PA.—Johnstown Tel. Co., E. D. Schade.

POCOMOKE, MD.—Poco. Tel. Co., W. H. Walters.

RUSH CITY, MINN.—North Eastern Tel. Co., A. J. Stowe, J. D. Markham.

CHICAGO, ILL.—United Tel. & Tel. Co., H. A. Harvey, W. T. Block.

DECATUR, IND.—Citizens' Tel. Co., F. W. Schirmeyer.

NEW IBERIA, LA.—Tel. Co. of Am., R. F. Broussard.

WASHINGTON, D. C.—Wash. Home Tel. Co., Jerome Penn.

BUFFALO, N. Y.—Frontier Tel. Co., C. E. Austin, C. L. Ingham.

ROCHESTER, N. Y.—Roch. Tel. Co., G. R. Fuller, C. E. Stinson.

MOBILE, ALA.—Home Tel. Co., W. H. Bryant.

TOPEKA, KAN.—Kan. Long-Dist. Tel. & Tel. Co., Fred. De Land.

YORK, PA.—York Tel. Co., G. B. Rudy, D. F. Lafean

KANSAS CITY, MO.—K. C. Home Tel. Co., O. C. Snider.

SAGINAW, MICH.—Valley Tel. Co., R. F. Johnson.

HOWELL, MICH.—Livingston Home Tel. Co., R. B. McPherson.

COLUMBIA, PA.—Col. Tel. Co., H. W. Johnson, H. C. Young.

MINNEAPOLIS, MINN.—Twin City Tel. Co., E. E. Webster.

Akron, Ohio.—People's Tel. Co., W. F. Lauback.
Coshocton, Ohio.—Citizens' Tel. Co., S. C. Kissner.
New York City.—Dutchess Co. Tel. Co., J. H. Scofield.
Philadelphia, Pa.—Keystone Tel. Co., R. H. Foederer, C. E. Wilson, W. H. Clark, W. W. Wharton, R. M. Eaton, J. Breen, J. M. Mack, M. Murphy, J. E. Ridgway, J. C. Perry, O. H. Larwill, R. A. Whittick, F. Herboth, Dr. L. Duncan, W. L. Hodges, C. K. Hagy.
Trenton, N. J.—Inter-State Tel. Co., A. M. Worstall, F. A. Demorest, J. J. Conner, J. C. Crawley.
Baltimore, Md.—Maryland Tel. & Tel. Co., H. W. Webb, E. H. Bouton, W. R. Whiting.
Cleveland, Ohio.—U. S. & Federal Tel. Cos., J. M. Thomas, H. D. Critchfield, H. H. Robinson, G. F. Du Perow, A. C. Morse; Consol Tel. Co., B. G. Hubbell.
Raleigh, N. C.—Raleigh Tel. Co., W. A. Wynne.
Morgantown, N. C.—Burke Co. Tel. Co., W. C. Ervin.
Cedar Rapids, Ia.—W. H. Durin.
Indianapolis, Ind.—New Long-Distance Tel. Co., S. P. Sheerin, H. W. Fox.
Bluffton, Ind.—H. Dougherty.
Camden, N. J.—Eastern Tel. & Tel. Co., E. A. Armstrong, W. W. Olheiser, J. J. Burleigh.
Fort Wayne, Ind.—Citizens' Tel Co., G. W. Beers.
Scranton, Pa.—S. E. Wayland.
Grand Rapids, Mich.—G. R. Tel. Co., E. B. Fisher.
El Paso, Tex.—Southern Ind. Tel. Co., Mrs. Annie McE. Brett.
Crawford, Ind.—Home Tel. Co., W. E. Nicholson.
Memphis, Tenn.—Mem. Tel. Co., H. Myers.
Zanesville, Ohio.—Zan. Tel. & Tel. Co., J. B. Rhodes, S. M. Granger.
Downington, Pa.—West Pa. Tel. Co., R. E. Russell.
Kent, Ohio.—Kent Home Tel. Co., W. H. Butler.
Hazleton, Pa.—Anthracite Tel. Co., C. A. Maus; People's Tel. Co., F. May, C. W. Kline.
Louisville, Ky.—Louisville Home Tel. Co., J. E. Zeluff.
St. Louis, Mo.—Kinloch Tel. Co., H. L. Reber.
Philadelphia, Pa.—United Tel. & Tel. Co., W. D. Barnard; Inter-State Tel. Co., C. E. Starr.
Syracuse, N. Y.—Syracuse Tel. Co., F. M. Potter, Jr.
Staunton, Va.—Staunton Tel. Co., N. C. Wetts.
New Britain, Conn.—Farmington Valley Tel. Co., R. L. Andrews, B. F. Case.
Mifflintown, Pa.—Consol. Tel. & Tel. Co.—A. G. Scholl.
Williamsport, Pa.—United Tel. & Tel. Co., N. E. Robb.
Jersey City, N. J.—State Tel. Co., G. H. Atkinson.
Columbus, Ohio.—Citizens' Tel. Co., F. L. Beam.
Binghamton, N. Y.—Binghamton Tel. & Tel. Co., E. Davis.
Portland, Me.—Northeastern Tel. Co., L. A. Goudy.
Munice, Ind.—Del. and Mad. Counties Tel. Co., W. E. Hitchcock, G. F. Trier.
Mobile, Ala.—Home Tel. Co., A. Glass.
Trenton, N. J.—Inter-State Tel. Co., B. C. Groh.
Pittsburg, Pa.—West. Penna. Tel. Co., T. B. Lee.
Grottoes, Va.—J. H. Livers.
Bristol, Conn.—A. R. Lamb.
Newton, N. J.—Sussex Tel. Co., J. M. Miller.
Lynchburg, Va.—Lynchburg Tel. Co., C. W. Scott.
Detroit, Mich.—People's Tel. Co., J. B. Ware.
Newtown, Pa.—Stand. Tel. & Tel. Co., H. H. Stevens, G. S. W. Brubacker.
Chrisman, Ill.—G. W. Fair.
Iowa City, Ia.—A. T. Pressen.
Connersville, Ind.—E. A. Frazee.
Louisville, Ky.—J. A. Armstrong.
Thibodaux, La.—L. H. Lancaster.
Wellsburg, W. Va.—W. K. Cummings.
La Crosse, Wis.—I. H. Moulton.

Notes and Exhibits.

Standard Underground Cable Company entertained its many friends and patrons at Room 5 of the Manufacturers' Club, just across the way. It was duly represented by Messrs. T. E. Hughes, Philadelphia, manager; R. N. Hirst, G. L. Wiley, manager of eastern sales department; P. H. W. Smith, assistant general manager at Pittsburg; A. B. Saurman, manager for the northeastern department at Boston, while General Manager Marsh, vice president, though not much seen, had button 74 against his name as an attendant.

The Maybury-Holmes Party-Line was exhibited in operation in the Keystone Telephone Building. This system is selective. Subscribers not wanted are locked out and are warned that the line is busy. The exhibit was in charge of Messrs. F. E. Maybury and N. H. Holland. The company's address is West Medford, Mass. The basic principle is the engagement and release of a punctured disc by a vertical finger on the receiver lever.

The Russell-Tomlinson Electric Company, Danbury, Conn., was represented by Mr. W. E. Russell. It exhibited in the Keystone Telephone Building its three new types of desk instruments, also receivers and transmitters. Literature was distributed, illustrating its full line of instruments and apparatus.

Vallee Bros. Electrical Company, the prominent Philadelphia supply firm, was represented by its manager, Mr. Thomas L. Townsend.

Leon W. Pullen and R. S. Pullen, of The Leon W. Pullen Electric Company, Philadelphia, were at the convention.

Mr. A. Atwater Kent, of the Atwater Kent Mfg. Works, Philadelphia, was at the convention. This company manufacture the "Monoplex" telephone and popular priced telephone outfits.

H. C. Roberts & Co., Philadelphia, the well-known supply dealers, were represented at the convention by Messrs. H. C. Roberts and John Mustard.

The D. & W. Fuse Company, Providence, R. I., exhibited its admirable telephone protector in its improved form. The company was represented by Mr. W. S. Sisson, the secretary, Mr. W. J. Leggett and Mr. F. C. Jaeger.

New Haven Novelty Machine Company.—The exhibit of the New Haven (Conn.) Novelty Machine Company in the Keystone Telephone Building attracted a great deal of attention. Its main feature was the demonstration of the convenience, economy and waterproof qualities of the "Novelty Slideable Sleeve" and fittings for cable connections, as noted in these pages last week. The gentlemen in charge were Messrs. H. Grant Thompson, Franklin A Thompson and Charles Luke.

The Electric Storage Battery Company had headquarters in parlors at the Walton, where its many friends were welcomed by Mr. E. L. Reynolds, Pa., sales manager, assisted by Messrs. R. C. Hull and H. B. Coho. The company exhibited some of the many types of "Chloride" accumulators, designed especially for telephone work, and called particular attention to the fact that this accumulator has been adopted as the standard for many of the central energy systems of the country. The telephone men were deeply interested in the improvements which have made the use of storage batteries in central energy systems a commercial and operative success, and in some new smaller types of cell shown for exchanges of minor size now adopting this method of operation.

The Helios-Upton Company, Philadelphia, were represented by Chas. D. Meyers and Harry Huskey. While this company made no formal exhibit, circulars were distributed illustrating and describing the Helios-Upton lightning arresters, cable terminals, enclosed fuses, enclosed sneak current protectors and their telephone batteries.

The Viaduct Manufacturing Company, Baltimore, was represented at the convention by Mr. Wm. O. M. Le Bawer, the secretary of the company, and by Mr. Marion B. Davis, their electrician. A central energy switchboard and instruments were exhibited in operation at the offices of the United Telephone and Telegraph Company, in the Fidelity Mutual Building.

Stromberg-Carlson Telephone Manufacturing Company had a very neat exhibit of their famous telephone apparatus at the Keystone Building, illustrating their various types of boards and other parts of their system now in use in some of the largest and best independent telephone exchanges in the country. The headquarters were visited by the delegates in large numbers, and among those prepared to receive them were Messrs. J. J. Nate, whose work did so much to make the recent Interstate affair, at Chicago, such a success; A. J. Rousseau, C. W. Stiger, Eugene L. Brown and S. L. Reese.

Gordon Battery Company had a neat exhibit of their specialties at the Walton, and Mr. W. C. Banks, of Chicago, was on hand to represent their interests.

American Electric Telephone Company, of Chicago, occupied

Rooms 913 and 915 at the Walton, and there received the calls of hosts of friends, many of whom are using the well-known apparatus in their exchanges. The company were represented by Pres. P. C. Burns and by Messrs. H. P. Clausen, John H. Reid, S. J. Bear, J. G. Ihmsen, general manager.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, were represented at the convention on Thursday by Pres. Henry Shafer, who was prevented from attending the opening by a trip through Canada, where he has just secured several large contracts for a complete central energy exchange equipment. Many of Mr. Shafer's warm personal friends in the independent telephone field complimented him on the many new features he has added to the durability and efficiency of telephone systems embodied in the construction of his company's lamp signal central energy double-supervisory, multiple and trunking switchboards and full line of telephones.

MANHATTAN ELECTRICAL SUPPLY COMPANY, of New York, was well represented by the veteran, I. M. Post.

DARLINGTON ELECTRIC SUPPLY COMPANY, of Philadelphia, was represented by Mr. D. Scott Quintin.

U. S. AUTOMATIC TELEPHONE COMPANY, of New York, having mercury cup contact apparatus for the receiver, etc., was represented by Mr. E. E. Ries, the well-known inventor.

AMERICAN TOLL TELEPHONE COMPANY, of Cleveland, Ohio, was represented by Messrs. W. A. Foss and J. R. McLean.

ERICSSON TELEPHONE COMPANY, of New York, whose admirable apparatus has but recently been illustrated in these pages, had a neat exhibit at the Walton of their switchboards, models of neatness and finish, and were represented by Messrs. K. Weman and C. E. Monroe.

"OKONITE" was ably, wholly and adequately represented by Mr. Geo. T. Manson, who bids fair to enjoy among the independents a well-deserved popularity long since won with a host of Bell friends, on personal grounds, and not forgetting the merits of the wire..

VALLEE ELECTRIC SUPPLY COMPANY, of Philadelphia, were represented by Mr. G. A. Vallee.

A WISSAHICKON DRIVE, given on Tuesday by the Keystone Telephone Company, was a delight to many who had never taken the trip through Fairmount Park. Several tallyhos were in line, and a halt was made for refreshments at the Indian Inn, in the Park.

THE CONVENTION MEETINGS were held in the ball room of the Walton, at the top of the house—a fine hall, but wofully far from the big exhibits in the Keystone Telephone Building. The distance militated seriously against full attendance, while it made inspection of the exhibits not an easy matter. There was plenty of room for the exhibits around the hall antechambers.

D. S. M. MANUFACTURING COMPANY, of Cleveland, were represented by Mr. G. S. Du Perow, who had an excellent little catalogue as to their telephone hardware specialties.

NATIONAL INDIA-RUBBER COMPANY sent Mr. H. Stanley as one who would probably know as many in the crowd as any other man present.

ELECTRICAL WORLD AND ENGINEER occupied Rooms 735-737 at the Walton, and was represented by Pres. J. M. Wakeman, Mr. G. W. Elliott, of the New York office; Mr. C. T. Walker, manager of the Philadelphia office, and Messrs. T. C. Martin and K. G. Martin, of the editorial staff.

ELECTRICAL BUREAU of the City of Philadelphia was represented by Chief John C. Sager, E. Burk, manager, and F. Maize, first assistant manager.

WALKER & KEPLER, of Philadelphia, were represented by Mr. H. G. Kepler and Mr. L. J. Costa.

NOVELTY ELECTRIC COMPANY, of Philadelphia, were represented by Secretary C. E. Trump.

AMERICAN ELECTRICAL WORKS, of Providence, who do a large amount of independent telephone work, were represented by Mr. W. J. Watson, of New York.

S. B. CONDIT, JR., & CO., Boston, Mass., was represented by Mr. S. B. Condit, Jr.

HON. R. F. BROUSSARD, M. C., vice-president of "The Telephone Company of America," Washington, D. C., was present.

G. H. GHARKY, of Philadelphia, attended the meetings.

MR. GEO. BREED, of Drake, Breed Company, Philadelphia, was in frequent attendance.

THE AMERICAN CONTRACTING COMPANY OF NEW YORK was represented by J. H. Scofield.

MR. B. S. BARNARD looked after the interests of the American Vitrified Conduit Company of New York, and had a small exhibit in the convention room.

GEN. C. H. BARNEY, of the Monarch Fire Appliance Company, New York, greeted his many friends in the interests of Kilfyre, and distributed a very neat and useful match safe.

THE F. BISSELL COMPANY, Toledo, Ohio, had an exhibit in their room in the Hotel Walton in charge of Mr. C. M. Hamilton. This exhibit included an assortment of their pole line specialties. Among these were pole seats, conduit rods, man-hole guards, cable distributing boards and trolleys for stringing cables.

GRAY TELEPHONE PAY STATION, of Hartford, Conn., was ably represented by Mr. E. B. Baker, one of the best posted men going on telephony.

ILLINOIS ELECTRIC SPECIALTY COMPANY, of Chicago, sent Mr. F. B. Patton and Mr. P. J. Hertz.

MCROY CLAY WORKS might have been forgotten but for E. F. Kirkpatrick, but with "Kirk" present it was hard to think of anything else. Mr. A Bournonville, of Philadelphia, assisted him in his indefatigable efforts.

VARLEY DUPLEX MAGNET COMPANY, of New York, had Mr. J. M. Knox on the ground to speak in behalf of their excellent spools.

RAWSON ELECTRIC COMPANY, of Elyria, Ohio, were represented by Mr. S. B. Rawson himself.

HARRISON CONSTRUCTION COMPANY, of Cincinnati, were represented by Mr. P. J. Eubanks.

WACLARK WIRE COMPANY, of New York, had an active spokesman in Mr. H. F. Sanville.

SMETHHURST & ALLEN, of Philadelphia, were represented by W. A. Smethhurst and R. D. Allen.

WARNER ELECTRIC COMPANY, of Muncie, Ind., had a fitting and able exponent of their ingenious and excellent pole-changer in Mr. T. W. Warner himself, who showed the apparatus working in connection with the Kellogg exhibit. He distributed also some excellent literature as to this "ringer."

EDISON LAMP WORKS of the General Electric Company were represented by Messrs. F. W. Willcox and H. Westberry, who had much sought-after souvenirs in the shape of miniature lamps as pins and watch charms. Their presence is readily understood in view of the enormous importance of the modern lamp-signal board, to which Mr. Willcox is applying much of the experience learned in other fields.

AMERICAN ELECTRIC FUSE COMPANY, of Chicago, had Mr. Frank C. Jones present to discuss the merits of their familiar apparatus.

ERNER-HOPKINS COMPANY, of Columbus, Ohio, were represented by Mr. W. A. Hopkins, Jr.

STERLING ELECTRIC COMPANY, of Lafayette, Ind., needed no better spokesman than the popular and ubiquitous W. E. Doolittle, the life of every group.

WILLIAMS-ABBOTT COMPANY, of Cleveland, sent Mr. L. Sands and Mr. S. A. Duval.

NUNGESSER ELECTRIC BATTERY, of Cleveland, was very appropriately explained by Mr. B. P. Nungesser.

HUBBARD & CO., of Pittsburg, were represented by Mr. C. Seyler, who distributed a fine catalogue of their pole-line material.

NATIONAL CONDUIT AND CABLE COMPANY, of New York, were represented by Messrs. J. P. McQuade, Eckert and Beylard.

MR. C. A. BROWN, the well-known patent attorney of Chicago, was in town on legal business and could not resist the temptation to drop in on a telephone convention. The art is one he is deeply familiar with these many years.

MR. J. ALLEN HEANY, of Philadelphia, the well-known inventor, attended the meetings, and took much interest in the exhibits.

THE SUMTER TELEPHONE MANUFACTURING COMPANY.—Sumter, S. C., had an impressive exhibit of instruments and parts in Room 900, Hotel Walton. Their new central energy instrument attracted a great deal of attention on account of its compact and convenient form. This company make their own woodwork, and pay special attention to variety and excellence of finish. The exhibit was in charge of Mr. F. C. Manning and Mr. L. G. LeBourveau.

JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., were ably represented at their headquarters in the Walton by Messrs. W. L. Doyle, U. G. Tingley, D. F. Ivins, C. B. Cushing and G. W. Swan.

MR. J. R. WILSON, of the Crocker-Wheeler Electric Company, Ampere, N. J., was at the convention looking after the interests of that company, which has its dynamotor apparatus in a large number of telephone exchanges all over the country.

THE SWEDISH-AMERICAN COMPANY exhibited in the Walton, and its interests were represented by Mr. E. B. Overshiner, who distributed a very neat perfect miniature telephone.

KELLOGG SWITCHBOARD AND SUPPLY COMPANY had a splendid auxiliary exhibit in the Keystone Building. They were represented by Kempster B. Miller, J. C. Belden, Paul W. Bossert, A. E. Barker, S. C. Platt, Arthur B. Kratz, F. J. Dommerque.

JAMES G. BIDDLE, of Philadelphia, made an impressive exhibit of electrical instruments at Room 933, Hotel Walton. It consisted chiefly of cable testing apparatus, a special feature being made of Fisher cable testing sets, which appeal strongly to telephone engineers. These sets are largely used by the U. S. Government as well as by cable manufacturers, telephone exchanges, etc. Mr. Biddle also exhibited a line of high-grade condensers for central energy systems.

LAMBERT SCHMIDT TELEPHONE MANUFACTURING COMPANY had an exhibit at the Keystone Telephone Building of a 200-line common battery switchboard, using automatic self-restoring line drops, supervisory lamps, combination listening and ringing cams, and a 10-drop bridging terminal switchboard, using cams instead of cords, plugs and jacks. They showed in addition to these handsome samples of their switchboard work, a full line of multiple strips, receivers, etc. This exhibit, which attracted much attention, was in charge of Messrs. Lambert Schmidt, Roach and Bostwick.

HOLTZER-CABOT ELECTRIC COMPANY, of Brookline, Mass., represented by Messrs. J. J. Estabrook and D. M. Bliss, in the Keystone Telephone Building, a variety of apparatus, including a Ness automatic desk set, their magneto signalling apparatus, a ringer-dynamotor, for giving alternating current for ringing, and a pulsating current for party-line signals; a small interior telephone for hotel and domestic use, equipped with a new self-contained hook, provided with a silver-pointed rubbing contact, and similar button.

NORTH ELECTRIC COMPANY, of Cleveland, got in on the ground floor at the Keystone Telephone Building, where they had a most artistically arranged room. They had several switchboards set up and in full working order, taking current from a set of chloride accumulators. They illustrated their common battery, target signal system, and magneto switchboards, all set up and running. Their No. 14 switchboard attracted a large amount of well-deserved attention, being available as an automatic target signal, a central calling battery, or a local talking battery, with full supervision, equipped for 100 supervisory lines and 10 toll lines. The North Company, somewhat along the lines of the Globe-Wernicke multiple bookcase people, have worked out a most ingenious, useful and economical system of "unitype" switchboards, which consist of single sections or units uniform in style and appearance, which can be placed side by side, making at once a continuous frame and an extensible exchange, so that as the system grows, the old smaller board need not be scrapped, but can be utilized with newer sections. they were shown as magneto call, target and lamp signal boards in units of 100 or 200 lines. The plan elicited universal admiration as the "Farthest North" in telephony. All the details of the North system were also shown on tables for close exmaination as to parts, durability, etc. The company were represented by Messrs. C. H. North, R. Hendrickson and F. F. Sapp.

ALFRED F. MOORE, E. B. Bartram and W. W. Pawling, of "Alfred F. Moore," Philadelphia, the well-known manufacturers of insulated wire, greeted their many friends among the telephone fraternity.

J. L. PUTNAM and Louis Stillings, of the Clark Automatic Telephone Switchboard Company, Providence, R. I., were very much in evidence at the convention.

CHASE SHAWMUT COMPANY, Boston, Mass., the well-known manufacturers of electrical specialties, were represented by Harry P. Moore. Literature illustrating and descriptive of their "Boston Cable Clip" was distributed freely.

THE WESTERN ELECTRIC COMPANY was represented by Messrs. H. G. Braynard and Fred C. Jaeger, of the Philadelphia store, and they seemed to find themselves very much at home among the independents.

PROF. W. E. GOLDSBOROUGH, of Purdue University, was not only able, as superintendent of its electrical exhibits, to address the convention very instructively as to the St. Louis Fair, but as conducting the only university telephone course in the country, had many opportunities to discuss the desirability of such a course, its prospects and the outlook for young telephone engineers.

THE KEYSTONE TELEPHONE COMPANY, whose exchange was naturally the greatest exhibit and feature of interest at the convention, has now in operation approximately 4,000 telephones connected to the two exchanges known as the Main Exchange, located at Second and Sansom Streets, and the Race Exchange, at Sixteenth and Summer Streets. These two exchanges have both been illustrated and described in the pages of ELECTRICAL WORLD AND ENGINEER. A third exchange, to be located on the corner of Preston and Filbert Streets, is now in the process of construction, and it is anticipated that the exchange will be in operation some time in July. All three of the above exchanges are equipped with complete exchange apparatus furnished by the Kellogg Switchboard and Supply Company. A peculiarity of the Kellogg system, as there seen, is, that all the jacks in the switchboard are disconnected from the lines with which they are associated at all times excepting when they are actually in use for conversation. This is managed by the cut-off relay in the line circuit which at the same time that the lamp signal circuit is disconnected, connects the jacks to the line. In the Kellogg system the worst that can happen when stray currents get in is the destruction of the relay upon the particular line which has come in contact with the wire carrying the foreign current. The relays being individually mounted on the mounting strip, and individually encased in a drawn metallic shell, the damage is confined to the part immediately concerned. Another point in connection with the Kellogg exchanges, is that the jacks on the line have but one spring, and but two metallic connections. The tip of the plug connects with the spring of the jack, and the sleeve of the plug connects to the sleeve of the jack. The sleeve of the jack is also used to furnish the click in the operator's ear, which acts as a busy test. The simplicity of the circuits connected with this system render its liability to trouble very small. Paired cable can be used in the multiple which renders the laying up of the multiple very neat and compact; at the same time, the jacks, having but two soldered connections, are not subject to the ordinary troubles which have heretofore been common in the multiples containing 3, 4, or 5 wires. On account of this feature, several new exchanges now being built by the Kellogg Company will be equipped with jacks which are mounted in strips on three-tenths each centers, notably the big exchanges for Buffalo and Los Angeles, Cal. By this means, it will be possible to place a very much larger number of multiple jacks within the reach of a single operator than has generally been possible. Another feature of the equipment in use in Philadelphia is the mechanical construction of all the relays which are used on the system. The armatures of the relays are bent around the end of the core at an angle which is slightly greater than 90 degrees; the end of the armature which is next to the end of the core, is drawn toward the magnet by the action of the current, and by so doing the opposite end of the armature which engages the springs is raised, thereby making or breaking the spring contacts as desired. This armature is mounted upon a knife edge, eliminating the possibility of sticking. In general the system used by the Keystone Company may be described as a complete central energy multiple system having a two-wire multiple, a line and cut-off relay on each line with lamp signals, the relays being mounted on a rack in a separate room adjacent to the exchange. Supervisory lamps are connected with each cord, the relays controlling the lamps being mounted in the rear of the section. A main distributing frame and intermediate distributing frame are used; incoming and outgoing trunks having lamp supervision and operated in connection with order wires are included in the equipment. All current necessary for the operation of the exchange is furnished from a central battery consisting of two sets of eleven cells each of chloride accumulator battery, which is charged by a special telephone wound charging set which is installed in duplicate. These charging sets are manufactured by the Holtzer-Cabot Company, and are made according to specifications of the engineering department of the Kellogg Switchboard and Supply Company. On the trunk lines "busy back and don't answer" signals are given by means of two different kinds of noise which is introduced on the line from an interrupter and transformer operating in connection with the ringing generators.

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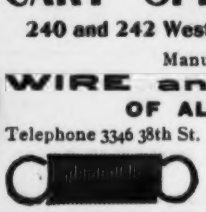

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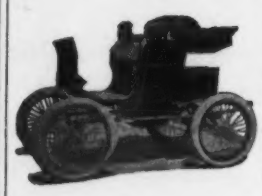

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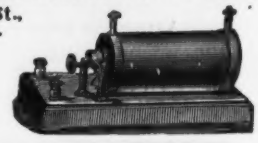

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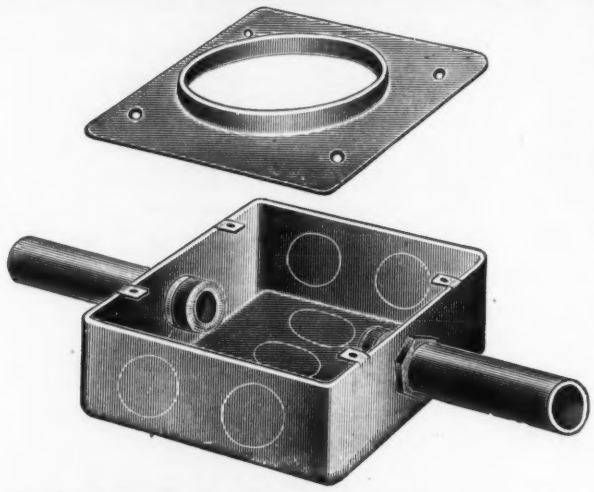

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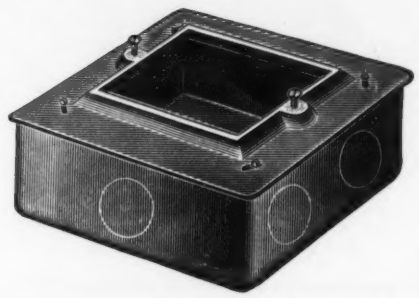

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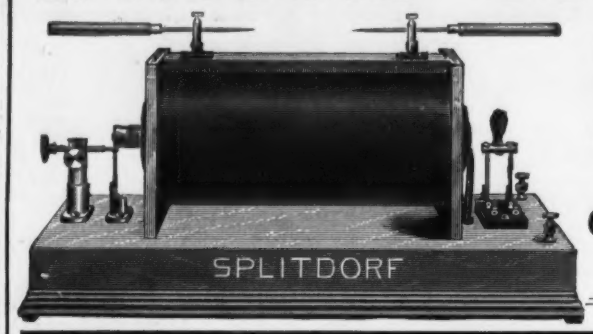

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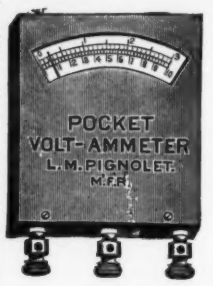

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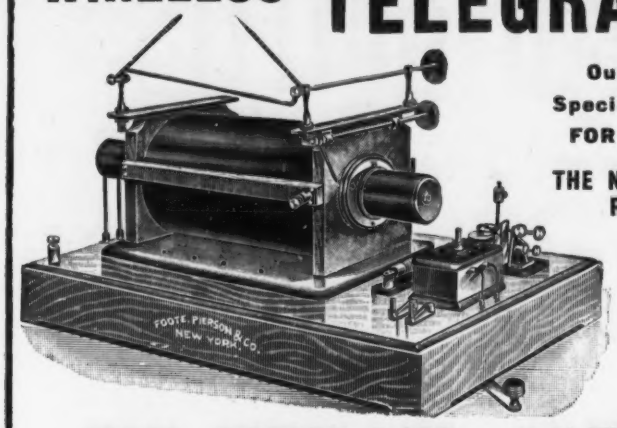

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If it is in the electrical line we have it, will get it, or make it—or it hasn't been invented. Perhaps we can invent it.

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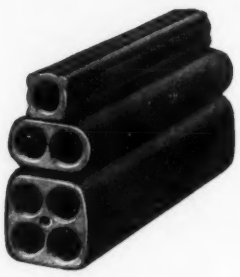

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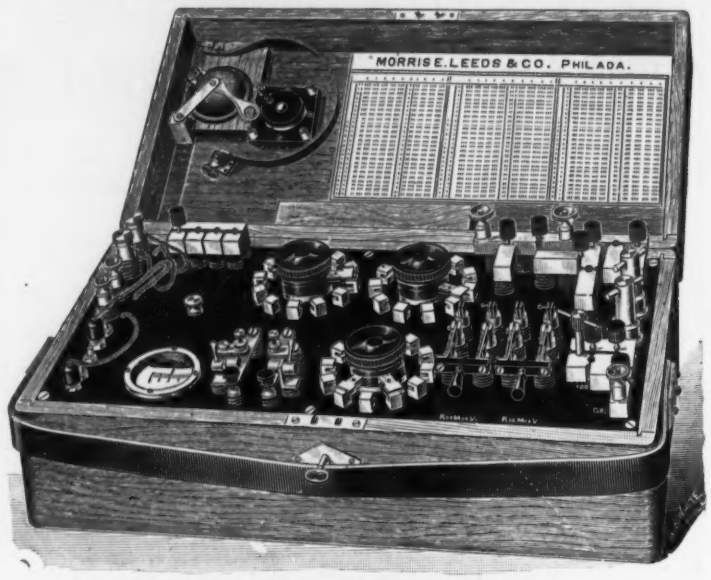
FISHER CABLE TESTING OUTFITS



Fisher Portable Cable Testing Set No. 2.

Recently a customer for one of these sets wrote: "We are pleased to advise you that we consider it everything that is claimed for it, and we will soon be in the market for another of the same type."

Up-to-date Telephone Engineers

Use "Fisher" instruments for testing cables and thus secure ACCURATE results with SPEED and CONVENIENCE.

Here are a few references: U. S. Signal Corps, Washington (8 sets); Standard Underground Cable Co., Pittsburgh (3 sets); Safety Insulated Wire & Cable Co., New York (3 sets); Reserve Construction Co., Cleveland (2 sets); India Rubber & Gutta Percha Insulating Co., Yonkers, N. Y.; W. R. Brixey, New York City; U. S. Engineer Office, Newport, R. I.; Maryland Telephone & Telegraph Co., Baltimore; Columbus Citizens Telephone Co., Columbus, O.; Zenith City Telephone Co., Duluth, Minn.; Conklin Construction Co., Aurora, Ill.; Central Construction Co., Toledo, O.; Keystone Telephone Co., Philadelphia; Bell Telephone Co., Philadelphia; Interstate Telephone Co., Trenton, N. J.; Nova Scotia Telephone Co., Halifax; Pittsburgh & Allegheny Telephone Co., Allegheny, Pa.; Japanese Imperial Telephone Exchange, Tokio; National Telephone Co., of W. Va., and others.

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BARE AND INSULATED

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OF EVERY DESCRIPTION

Catalogue on Application

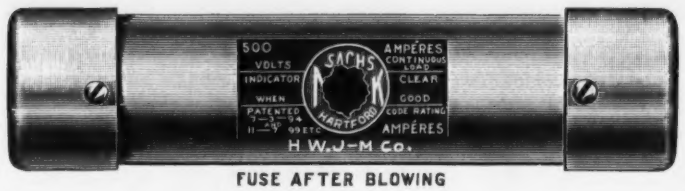
SACHS "NOARK" FUSES

FUSE BEFORE BLOWING

DO NOT ARC BUT INDICATE

NO MISS

YOU CAN TELL BY THE SPOT



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The Noark Fuse has a fusible conductor enclosed by a tube and a peculiar filling entirely surrounding the conductor. All arc or flash under short-circuit or any other condition of service is entirely eliminated by virtue of the enclosing casing and peculiar action of the filling. The blowing of the "Noark" Fuse under overload is an absolutely accurate and definite action occuring in a certain time interval for each definite increment of excess current.

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An Enclosed Fuse may not arc, but, in consequence of the enclosing casing, is still not safe, unless it at all times visibly indicates its condition. "Noark" Fuses do not arc but indicate.

This valuable feature is obtained by the use of a very small conductor in the casing, connected in shunt with the enclosed fuse, and which is disrupted coincidently with any interior action, visibly affecting the label which covers a portion of the indicator wire.

Claims are only Claims—but

Facts are Facts.

All we ask you to do is to compare any issue of

Electrical World and Engineer

with the corresponding issue of any other electrical journal and judge for yourself.

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The best antidote in the World for Heat is

COLONIAL FANS

NONE BETTER

DIRECT CURRENT, CEILING OR DESK. SEND US YOUR ORDERS. LOW PRICES. LARGE STOCK. PROMPT SHIPMENT : : : : : : : : : :

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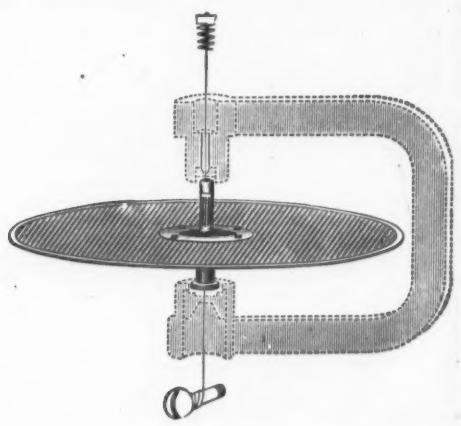
Send for description and book full of good information "ABOUT METERS"



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is a cell for all closed and open-circuit work. Water and bisulphate of mercury only are added. Four cells will drive any 12-inch fan motor not requiring over 10 volts.

DIFFERENT SIZES FOR VARIOUS WORK.

The battery will not polarize and has no local action. It is clean, easily operated, highly efficient, and decidedly economical. Each cell gives 1 1-2 volts and has a **LOW** internal Resistance.

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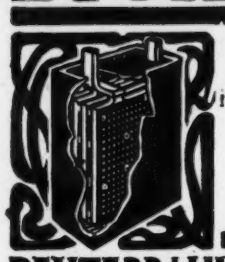

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We are the largest manufacturers of insulator pins in the world—can fill orders promptly. Get our prices before buying elsewhere.
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POLES, TIES, TIMBER,
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Switch Handles
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WE HAVE A LARGE ASSORTMENT OF MICHIGAN WHITE CEDAR POLES FROM 16 TO 70 FEET.

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Best { QUALITY FINISH DESIGN
The Cincinnati Tool Co.
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Our Last Pole Reports

(and they are up-to-date) show that we never had such a large stock at every yard as we have to-day. Just now we are a little slack. The poles along the railroad are pretty well picked up and the boats have not started coming in. (Weather's been pretty rough for June).

The whole situation conspires to give you prompt shipment no matter what the size of the order:—prices and quantity you already know about.

MALTBY LUMBER COMPANY
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CROSS ARMS
POLES—TIES
Prompt shipments direct from Mills—save brokerages and send us your inquiries.
MANUFACTURED BY
ECCLESTON LUMBER CO.,
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OCTAGONAL and SQUARE PINE POLES
FOR ELECTRIC RAILWAY and ELECTRIC LIGHT CONSTRUCTION.
We keep standard sizes in stock in our Southern stockyards and can cut special sizes at short notice.
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BOOKS ON ANY ELECTRICAL SUBJECT sent, prepaid, to any address in the world, upon receipt of price. Send for Catalogue.
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PROMPT SHIPMENTS CARGO LOTS
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THE ONLY TOOL MADE WHICH WILL DO THE WORK

No place inaccessible. Can use several sizes of staples. Can use it in the dark. No short circuiting. Great time saver. Try it for carpets, poultry, and other netting, etc. Handy around the house and office.

Other things of interest.

Keep your eyes on us for future developments.

We furnish dealers with circulars—with their name—free.

Send for Circulars and Information
MANUFACTURED BY
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15, 17, 19 Mill River St.
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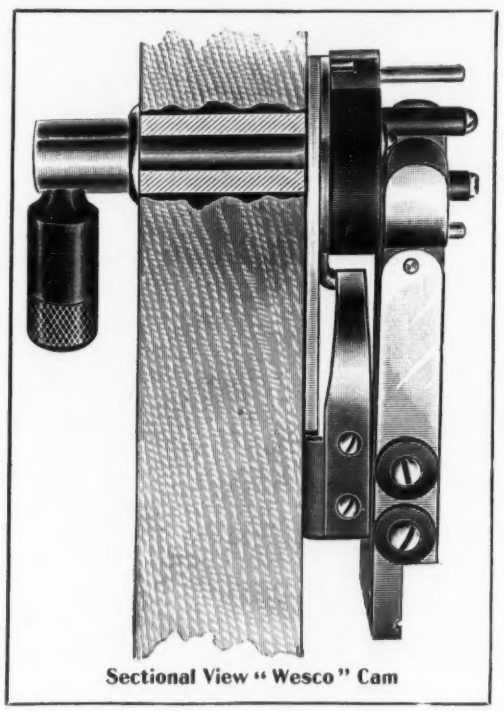
Don't Forget the Name "WESCO"

It is just another way of spelling merit and is the sum of

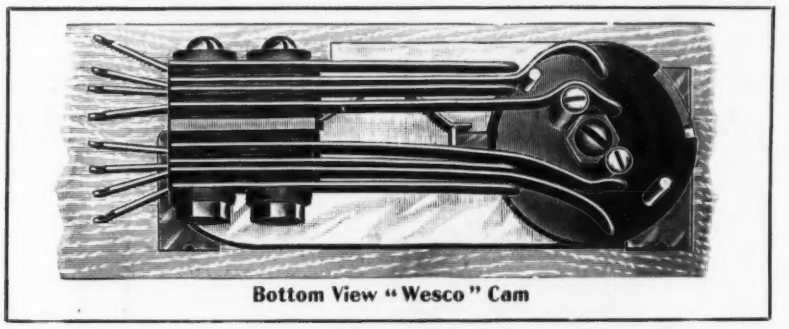
"Wesco" Combined Drop and Jack

W--WORTHINESS
E--ECONOMY
S--SATISFACTION
C--CONVENIENCE
O--OPPORTUNITY

Send us your switchboard inquiries; we will give you valuable information about our "Wesco" Telephone Apparatus without charge.



Sectional View "Wesco" Cam



Bottom View "Wesco" Cam

"Wesco" switchboards and telephones are not all that we supply. Our stock of construction material is most complete, while "Wesco" stands for another good thing---prompt shipment.

Western Electrical Supply Co.

ST. LOUIS, MO.

THE STANDARD FANS

This Advertisement is addressed to those readers of the Electrical World and Engineer who are not dealers in electric fans, but who, like ourselves, having not yet made their fortunes, are compelled to stay at their desks all through this hot weather. Would it not make life worth while to have a few of our desk fans scattered around your offices where they would do the most good—silently lowering your temperature by about twenty degrees—so you would feel like working? Why—you would not want to go home when night comes.

Don't stop to write for quotations. Telephone our agent, or wire in your orders if you are out of reach of an agency, and the fans will be billed at the right price.

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Does everything done by the ordinary Typewriter, as well, and faster.
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Writes on any horizontal surface that a Pen will.
THE ELLIOTT BOOK-TYPEWRITER
On paper of unlimited width, length or thickness.
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THE ELLIOTT BOOK-TYPEWRITER
And the only Typewriter as indispensable in the counting room as in correspondence.
THE ELLIOTT BOOK-TYPEWRITER
Not an experiment—5,000 in daily use.
THE ELLIOTT. BOOK-TYPEWRITER
Not advertised before, because manufacturing facilities have not, till recently, been sufficient to keep abreast with orders.
THE ELLIOTT BOOK-TYPEWRITER
Not more expensive than others; has often saved its entire cost in three months.
THE ELLIOTT BOOK-TYPEWRITER

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Write for circular showing definitely how the Elliott Book-Typewriter will save you money

NO LIMIT

TO OUR STOCK OF

DIRECT and ALTERNATING

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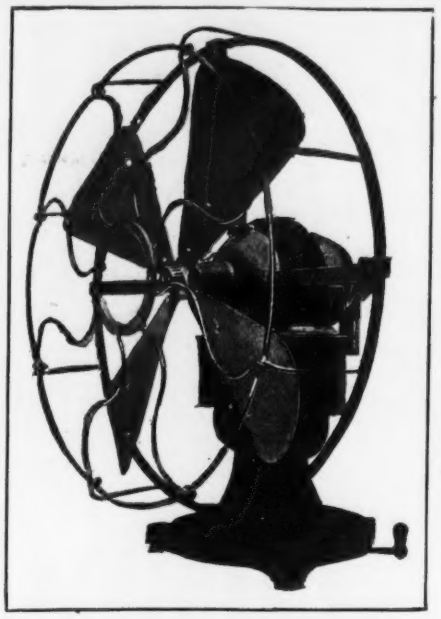

FANS

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SHOWING FULL LINE : : :

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CINCINNATI, OHIO

E. L. REINHOLD, President H. BURD CASSEL, Treasurer

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THE PENNSYLVANIA
ELECTRIC COMPANY

&

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IS A WONDER

CAPACITY
TWO CAR LOADS WEEKLY

NO FAN IS COMPLETE
WITHOUT OUR ARMATURE
COIL PROTECTOR

OUR TRUNNION
IS ENTIRELY NEW

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(COMPRESSED BITUMINOUS PAPER.)

Complete protection from **ELECTROLYSIS.** Makes the best and most inexpensive subways.

100 per cent. Better Service Over Wires in Them.

WATER, GAS, FROST PROOF.

7 foot lengths, 3 and 3½ inch Bore. Weight 2 lbs. to foot.

ESTIMATES GIVEN ON COMPLETE SUBWAYS.

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Write for our Catalogue of **ELECTRICAL BOOKS**

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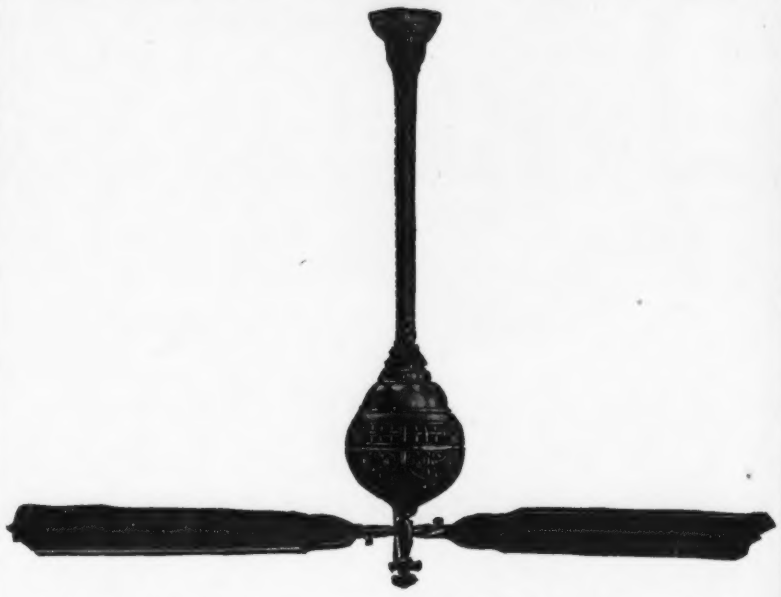
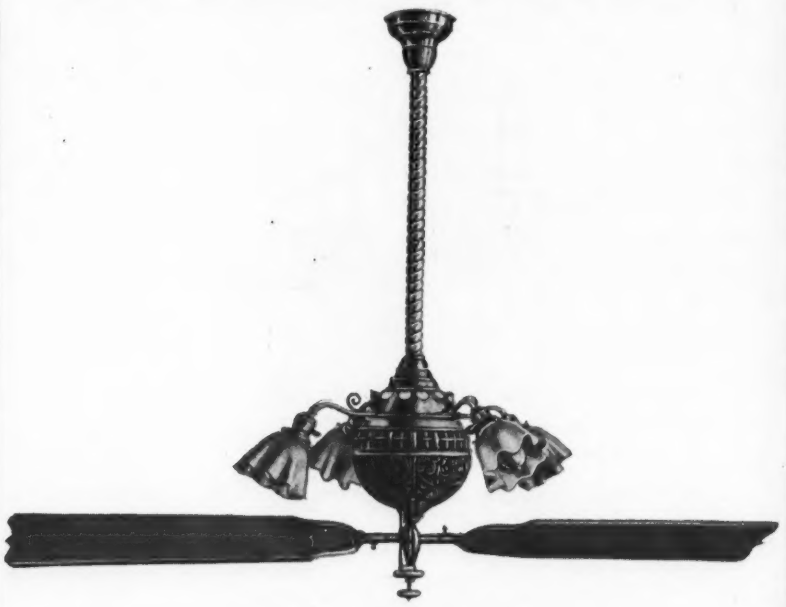


will run at full speed with a consumption of only from 90 to 100 watts, with a spread of 60 inches on blades and a width of 8 inches. They are supplied with our well-known spiral-grooved oiling system, and a stopping and starting switch, and blade adjuster, permitting the angle of the blades to be changed while fan is in motion.

Furnished to run on any cycle from 40 to 140, and any voltage from 50 to 230.

40 and 50-cycle Fans are equipped with special motor, giving speed of 180 revolutions per minute, and consuming only 90 watts.

Send for full information and prices before ordering elsewhere.



Hunter Fan and Motor Co.

FULTON, N. Y.

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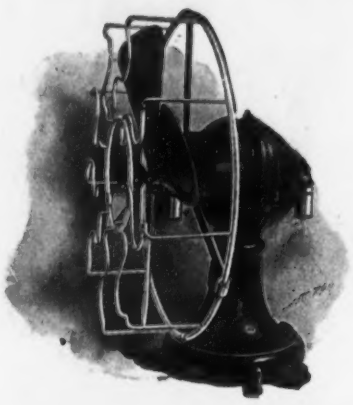
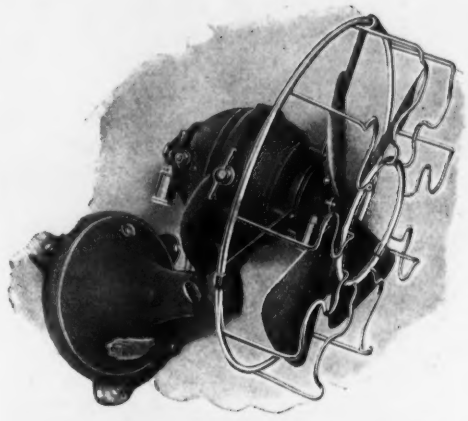
LUNDELL FANS

ARE COPIED BUT NEVER EQUALED

NO IMITATOR



has succeeded in equaling the efficiency and durability of the Lundell Fans. They are superior in design and construction and give the most satisfaction to dealers and users. The different types and sizes of Lundell Fans are sufficient to meet all requirements. Send for catalogue No. 3043.



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General Offices: 527-531 West 34th Street, New York.

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Established 1890.

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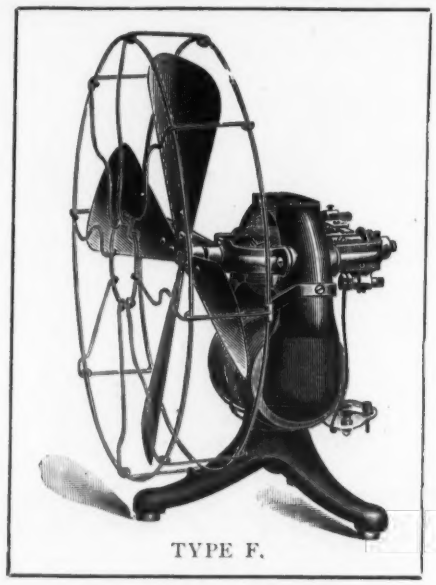

TYPE F.

... FANS ...

8-inch and 10-inch, stocked in two windings. 2 to 4 volts—5 to 10 volts.

KNAPP ELECTRIC & NOVELTY CO.

507 West 51st Street, NEW YORK

BATE'S ELECTRIC FANS

DIRECT CURRENT ONLY.

HIGHEST ELECTRICAL EFFICIENCY.

CEILING, DESK, WALL, COLUMN, BRACKET AND TRUNNION TYPE.

Our Fans have a National Reputation and are sold throughout the world and they give universal satisfaction. Before making contracts, write for catalogue to the manufacturers.

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I-T-E CIRCUIT BREAKERS

THINK

One of our customers recently said, I WANT TO GET A CIRCUIT BREAKER THAT CAN THINK. We built it for him. You think of a Circuit Breaker, say to us, I want a Circuit Breaker that will do so and so and this and that. The chances are that we have built exactly what you are thinking of, or could do so with some trifling modification of existing apparatus.

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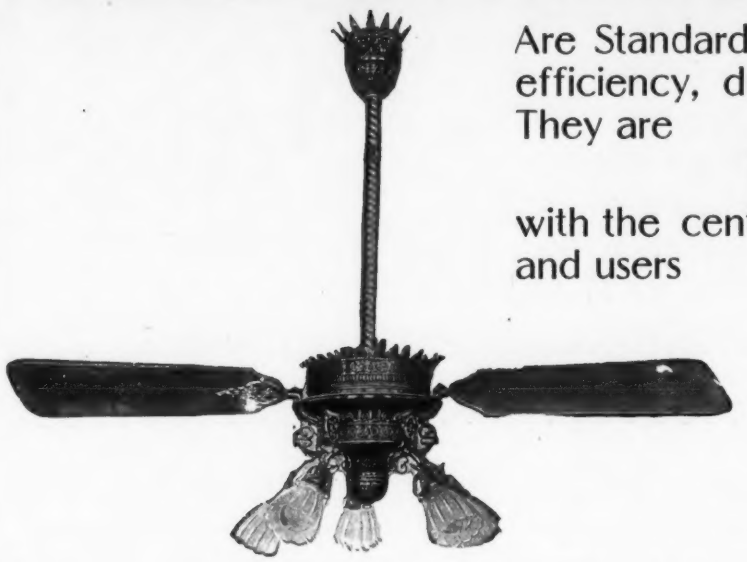
DIEHL ELECTRIC FANS



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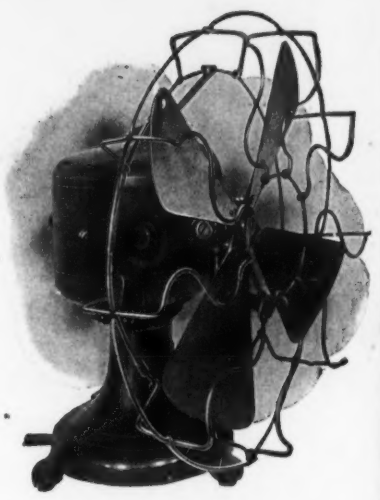
POPULAR

with the central station managers and users

BECAUSE

they circulate the maximum amount of air with a minimum amount of current.



2 types and 12 designs of Ceiling, Desk, Bracket and Trunnion in 3 sizes to select form.

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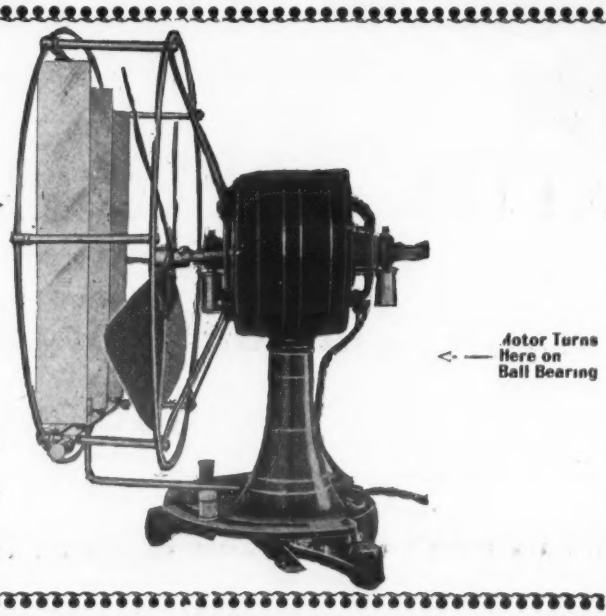
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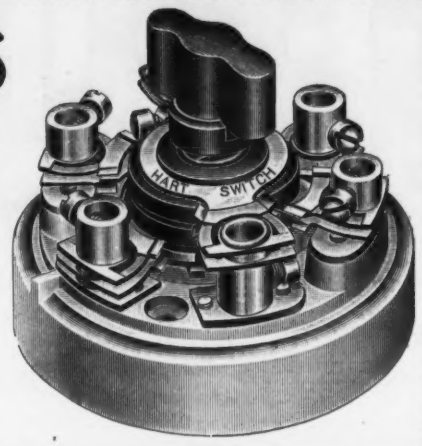

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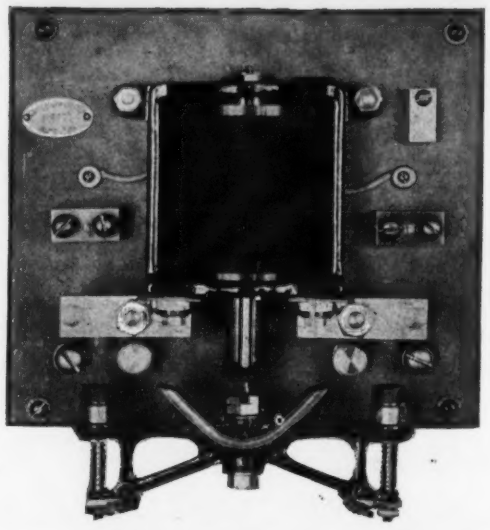

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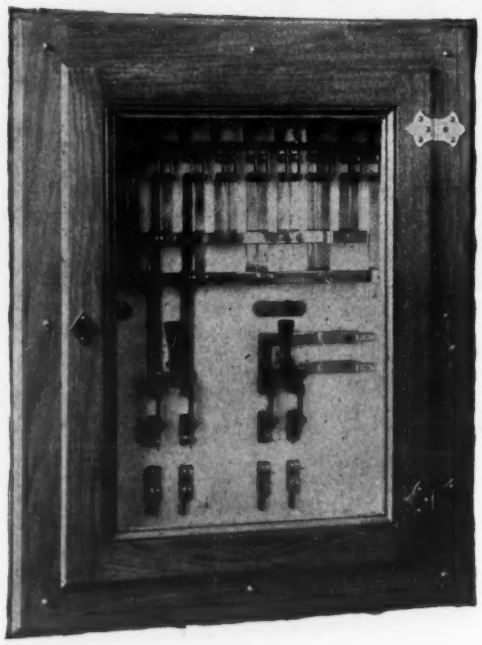

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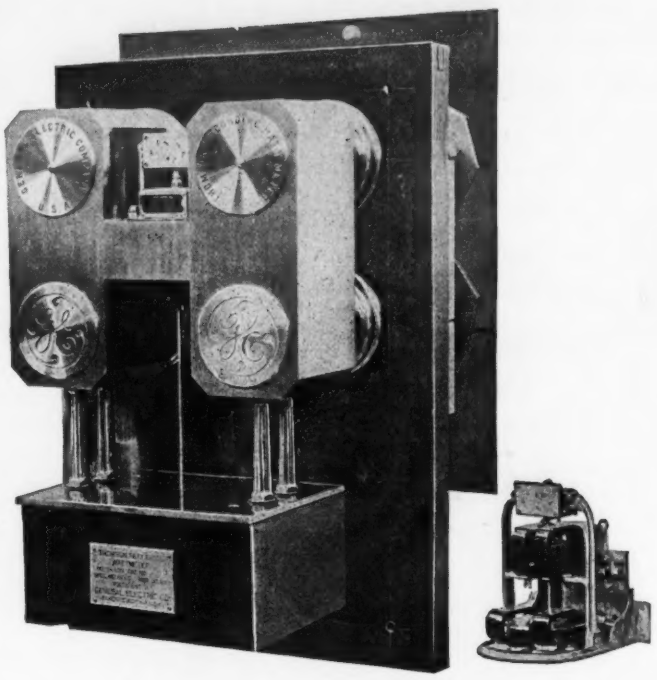

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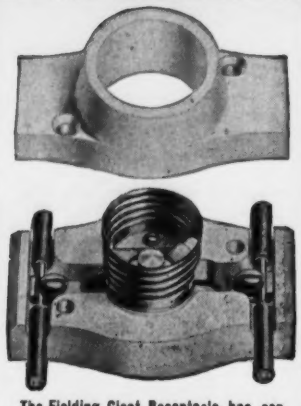

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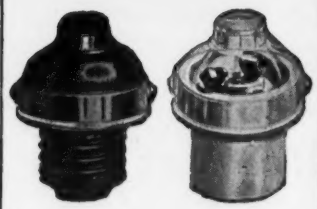

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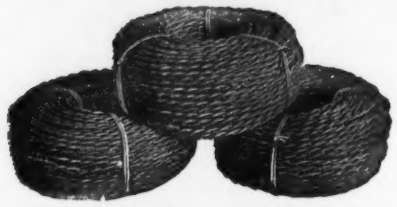

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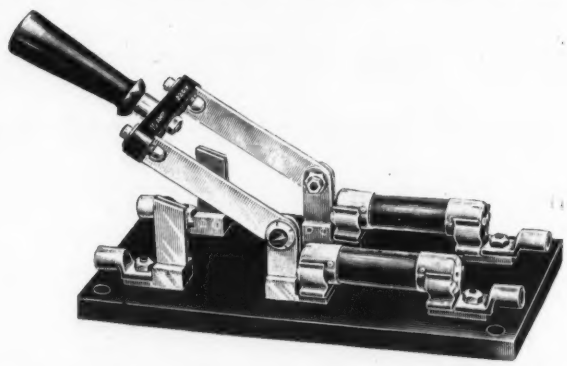

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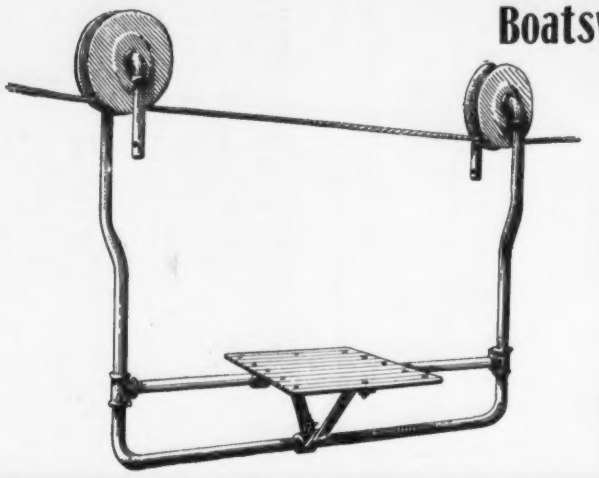

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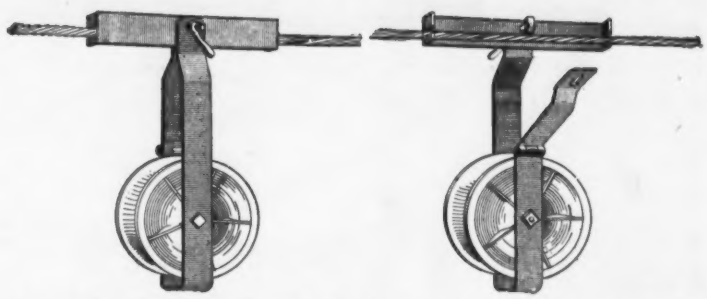

A thousand feet of cable is easily pulled *in ten minutes* by only two men after trolleys are in position. The trolleys can be attached by two men in one hour. The record for one gang of men in one day is ten thousand feet.

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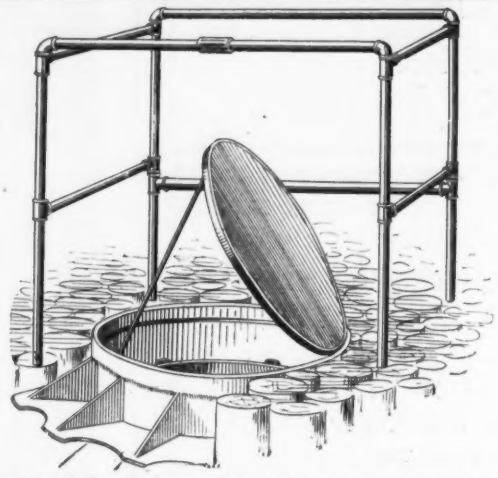

Contractors say that our manhole guards are cheap and are money savers, preventing accidents. They are made of three-quarter inch pipe, easily folded up and made portable, but when set and locked are rigid. The union in front top rail opens and the two arms swing out. Very convenient where work is being done in thoroughfares.

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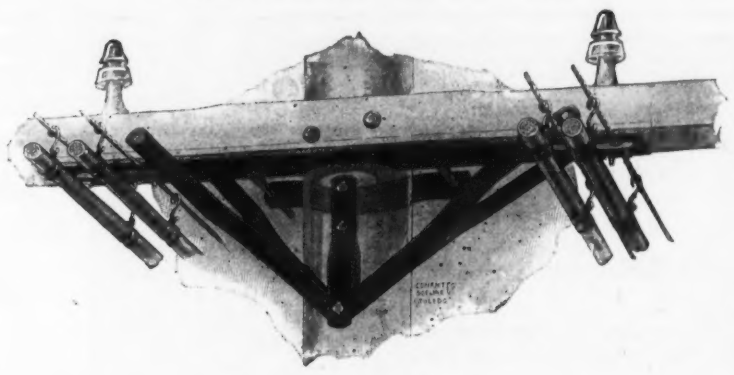

Angle Iron Cable Arms positively and permanently support all messengers and cables, and receive all strains. The wooden cross arm may be placed in the iron arm, as shown in cut, requiring no extra pole room. The iron arm is held by a very heavy rear clamp with two bolts, and also by two lags. It has two or four braces, as preferred, and the heel bolt is re-inforced by a stirrup. The arm will neither twist nor tilt under the heaviest strains.

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3x3x¼x42 inches; 1 pair braces, 8 clips	2.10
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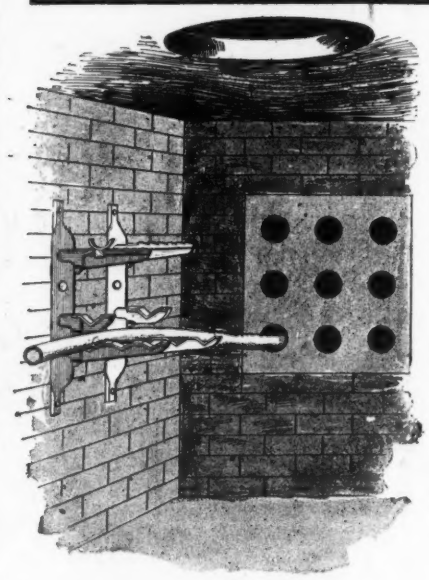

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Any arm can be removed without disturbing the others.

The arms enter from side of upright, with direct pressure against the edge of same, thus making a very strong upright with but little material.

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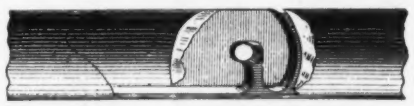

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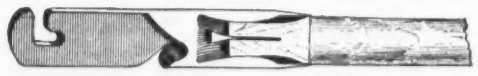

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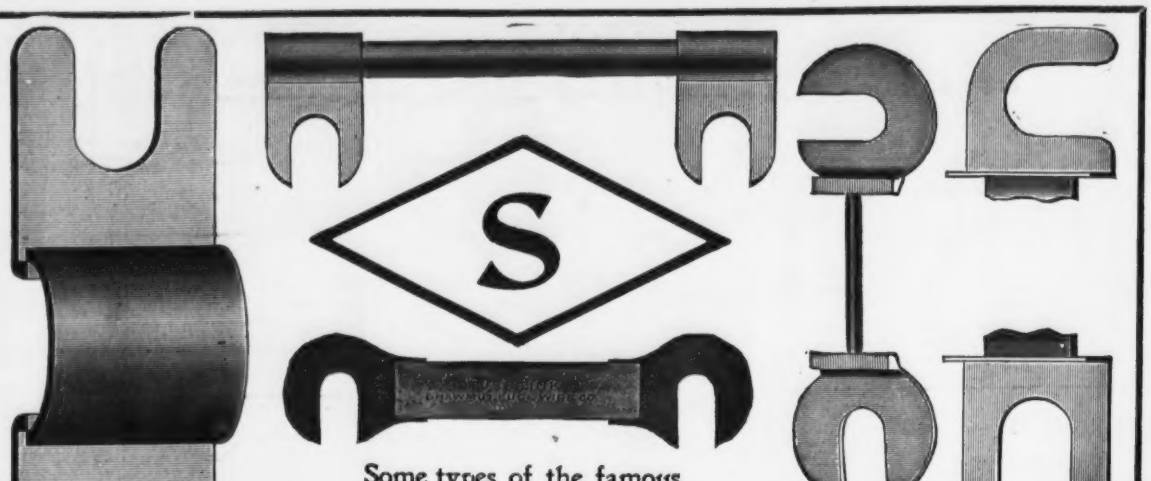

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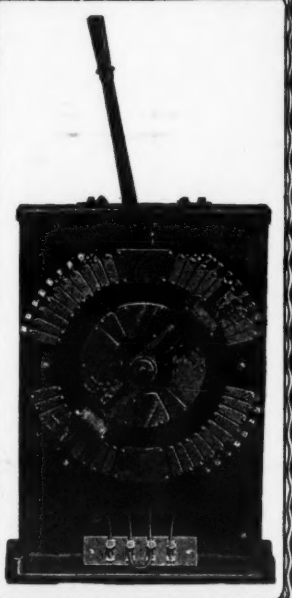

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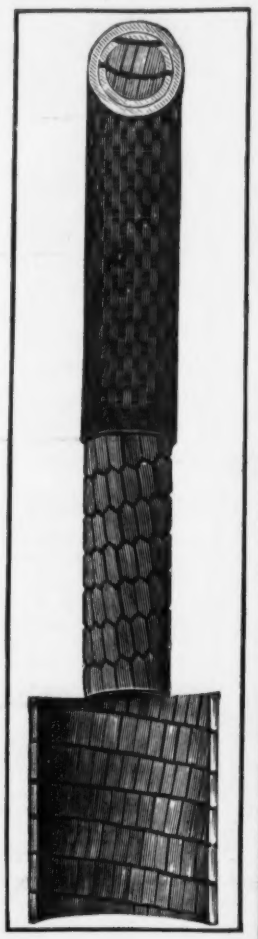

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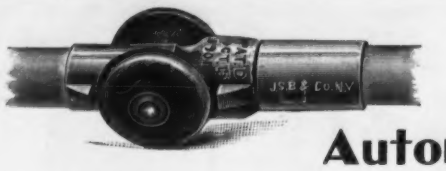

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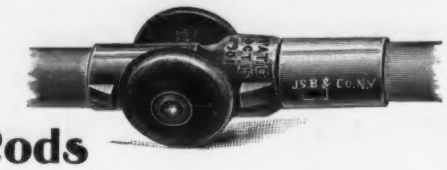

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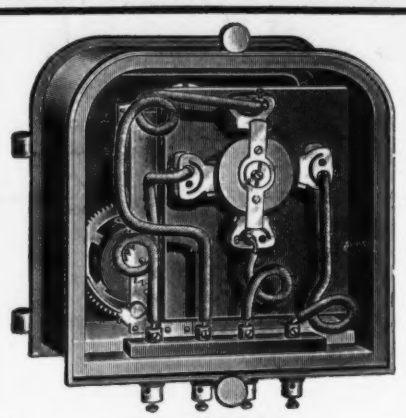

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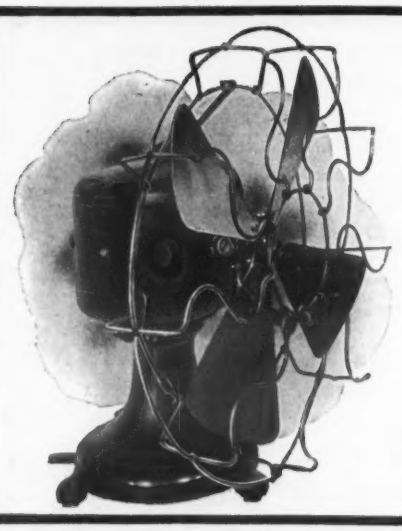

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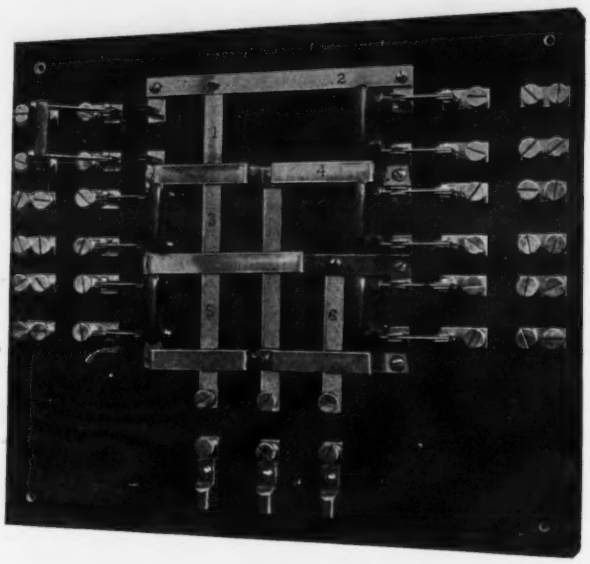

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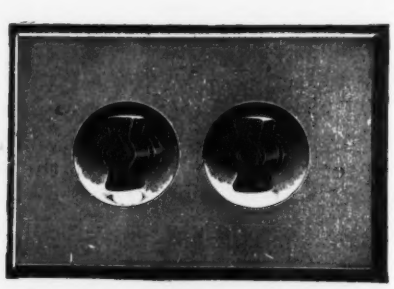

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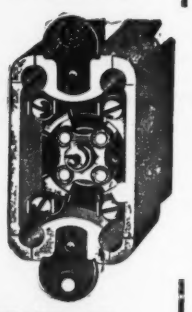
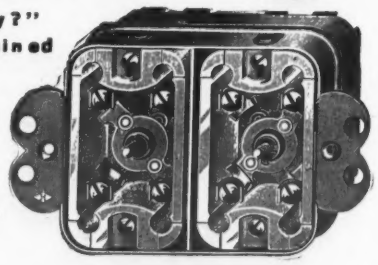


"Why?" Explained if you will ask.



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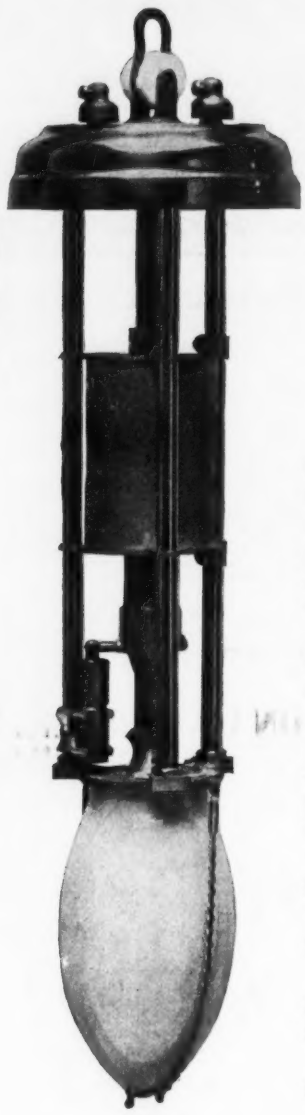

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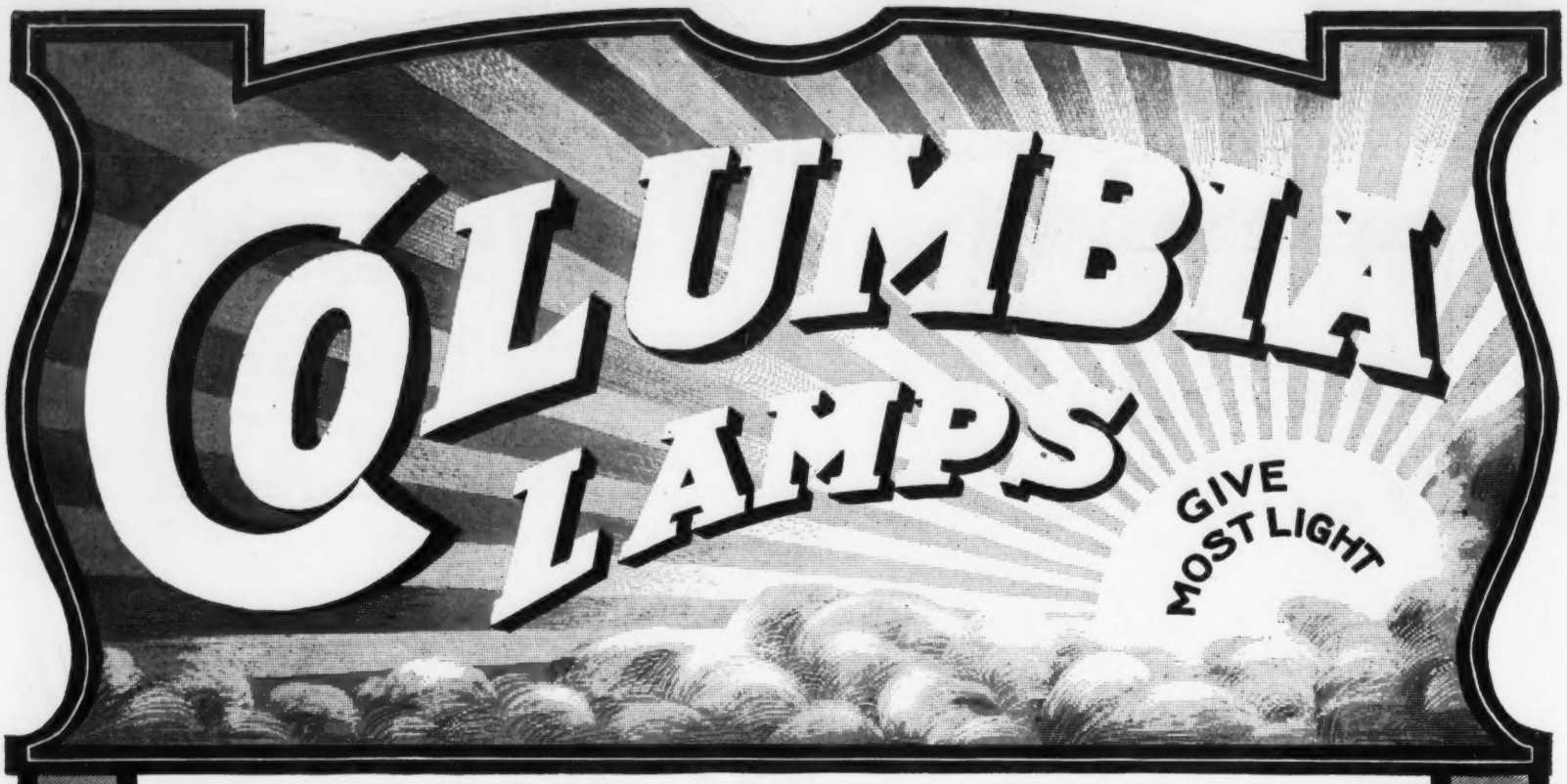

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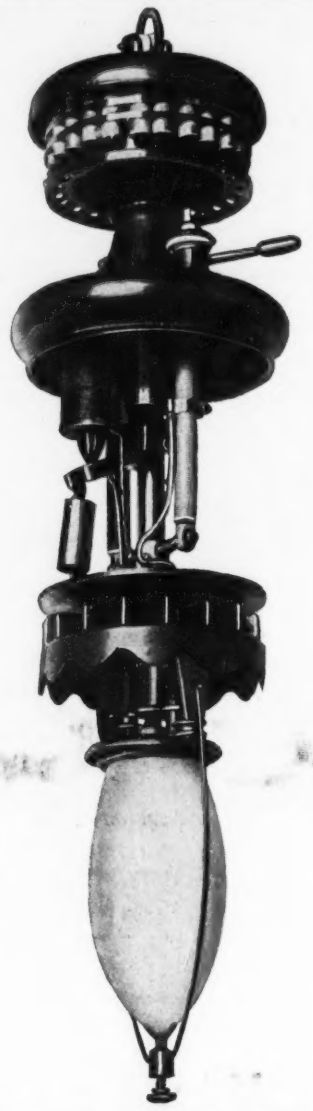

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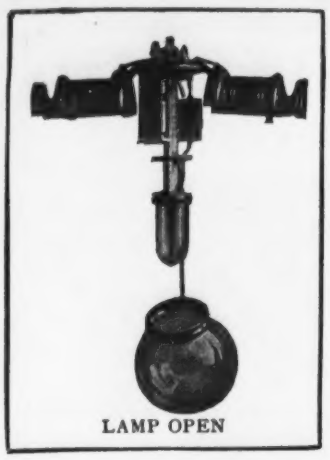
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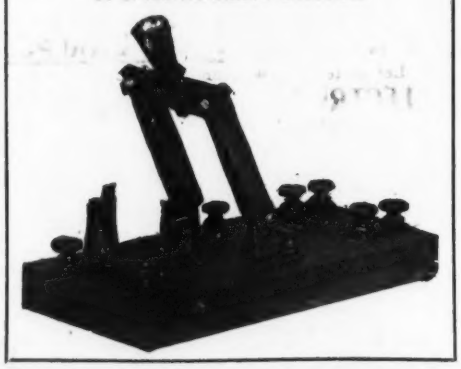

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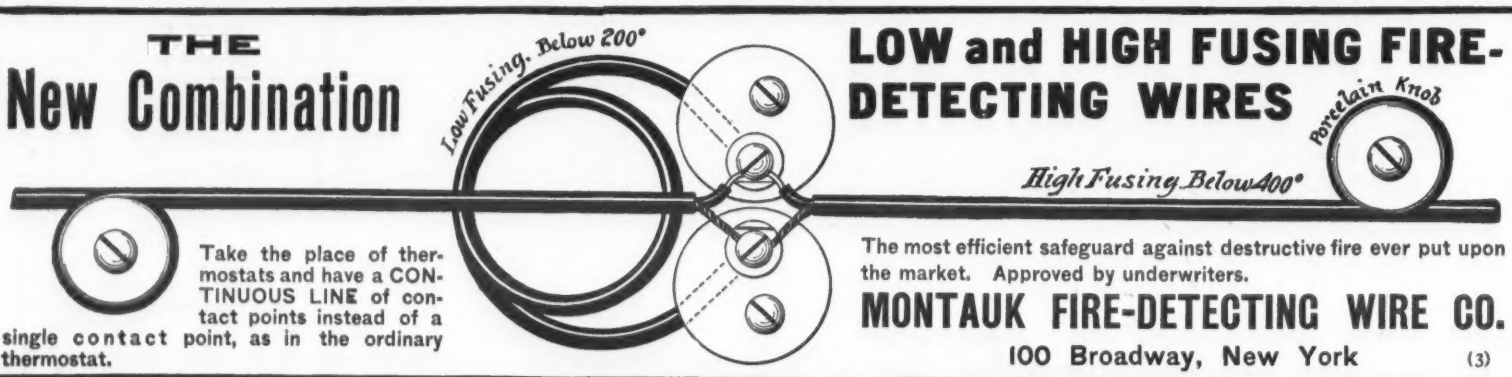

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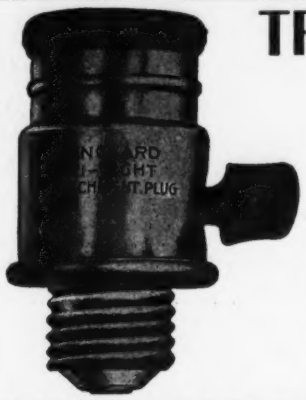

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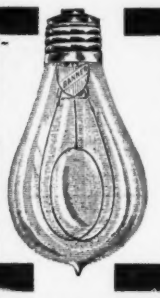

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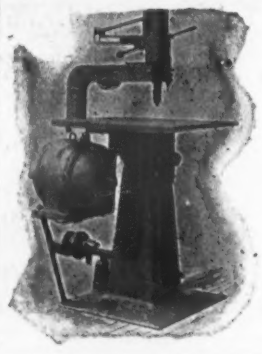

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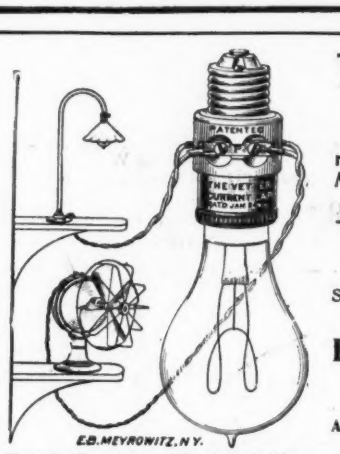

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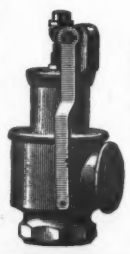

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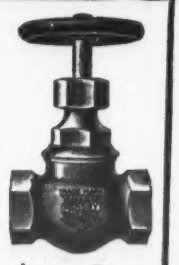

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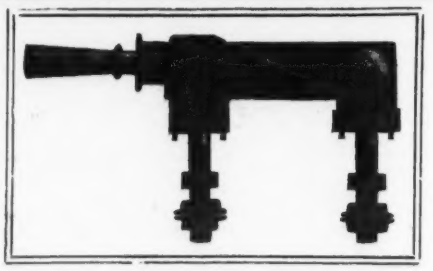

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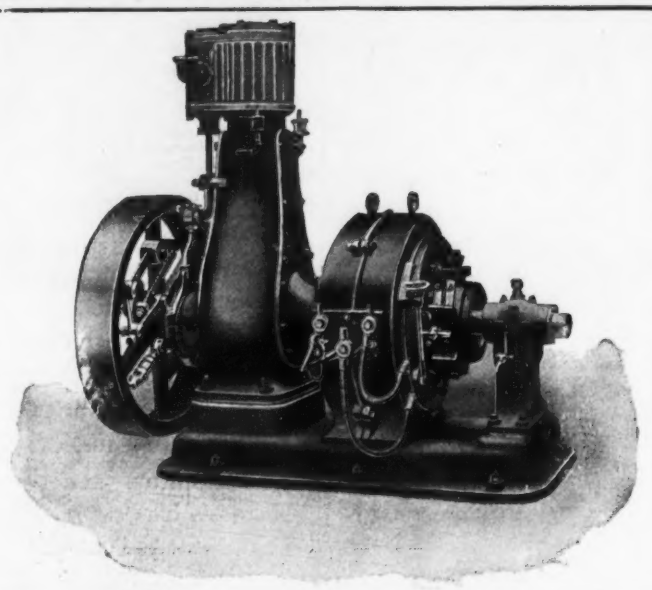

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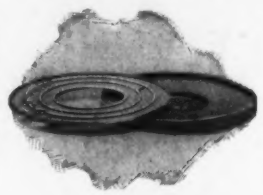

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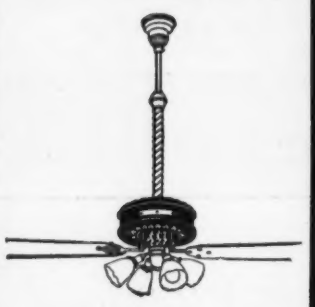

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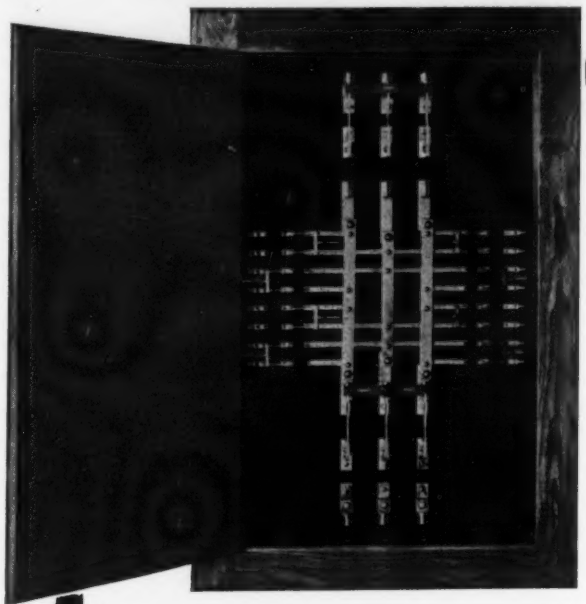

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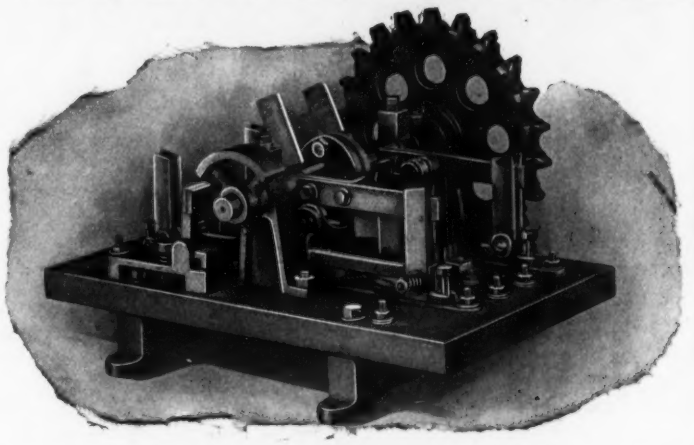

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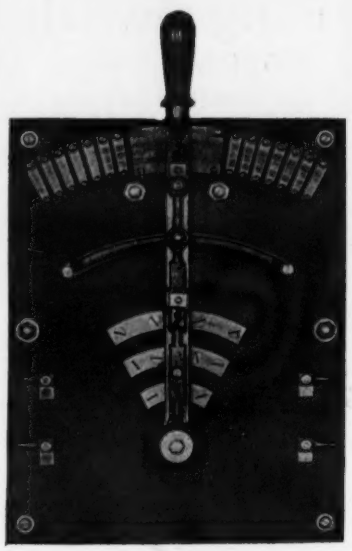

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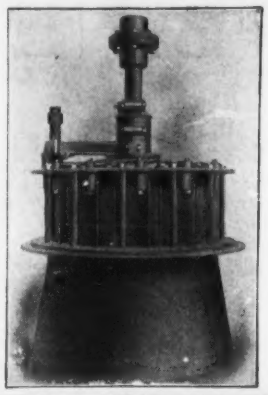

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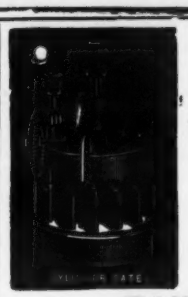

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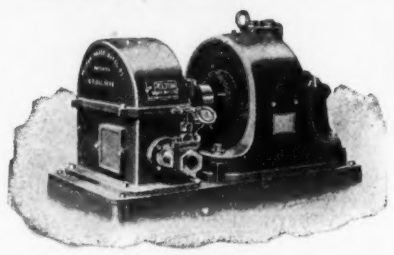

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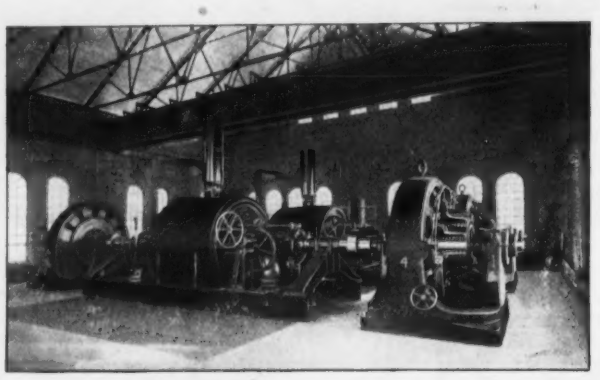

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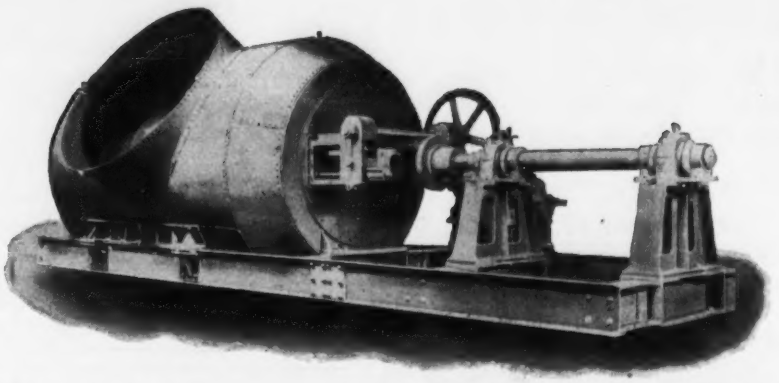

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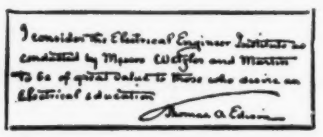
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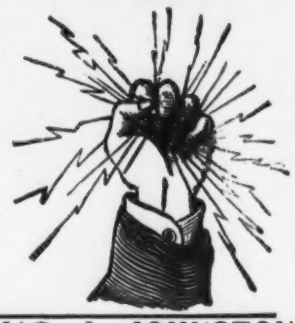

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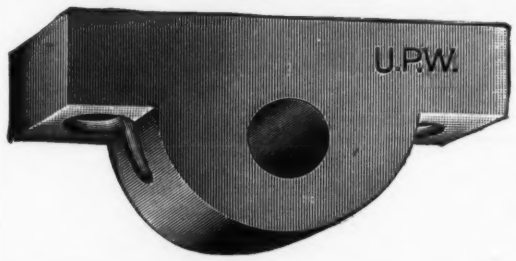

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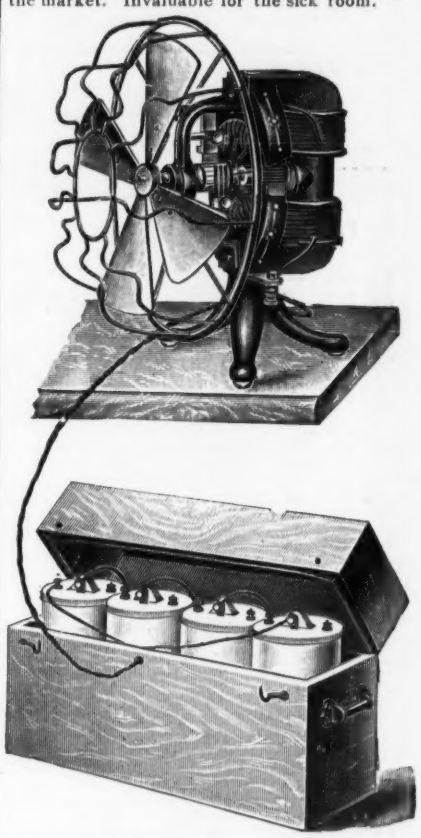

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POSITION WANTED with electric railway, light or power company by a technical college graduate; 7 years' practical experience in electric light and railway construction, overhead line, underground conduit, high-tension power station and motor equipment. Able to take position of manager, superintendent, or electrician; age 30. Address No. 332, care Electrical World and Engineer, New York.

POSITION WANTED by young man of 25 years (7 years in electrical business) as traveling salesman for the Middle States or South, with manufacturing company or supply house. Address, Harry Hodgson, 304 C Street, N. W., Washington, D. C.

POSITON WANTED by young man, 26 with seven years' practical experience in operating and construction of electrical, steam and compressed air machinery; desires position as superintendent or electrician of medium sized plant; capable of handling work and men; first class references; salary, $1,800; presently engaged but desire to change location. Address, No. 355, Electrical World and Engineer, New York.

POSITION WANTED by draftsman and designer; 6 years' experience in designing electrical apparatus and motors; age, 27; German, technical college graduate; want to change. Address, No. 356, care Electrical World and Engineer, New York.

YOU NEED IT!

GALES COMMUTATOR COMPOUND.

Gale's Commutator Compound.

The only Article that will Prevent Sparking.

Will keep the commutator in good condition and prevent cutting. Absolutely will not gum the brushes. **50c. per stick. $5.00 per dozen.** ***Send 50c. for trial stick.***

FOR SALE BY ALL SUPPLY HOUSES, OR

K. McLENNAN & CO., SOLE MANUFACTURERS, 909, 100 Washington Street, CHICAGO.

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U. S. METAL POLISH

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Sold by Dealers. Samples Free.

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POSITION WANTED by mechanical and electrical engineer, technical graduate, experienced in central station operation, desires a situation as superintendent of a medium size plant, or other position of responsibility in a central station. No. 357, care Electrical World & Engineer, New York.

POSITION WANTED as agent for telephone construction material and tools. Located at Fort Worth, Texas, and travel the State. Have had ten years' experience handling material as purchasing agent of large bell company. Best references. Commission basis only. Address, No. 354, care Electrical World and Engineer, New York.

POSITION WANTED by graduate of technical school (1901); preferably with construction company engaged in electric railway or power transmission work or with consulting engineer. Address, No. 358, Electrical World and Engineer, New York.

HELP WANTED.

The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each. Remittance should accompany order.

WANTED.—A young electrical engineer familiar with small motors and ventilation, to take up the engineering work of a new and promising business. Address, stating qualifications, No. 297, care Electrical World and Engineer, New York.

WANTED.—Armature winder and general repair man, who understands both alternating and direct current apparatus; to insure attention, state age, experience and remuneration expected; one willing to go South; a permanent position to the right party. Address No. 339, care Electrical World and Engineer, New York.

WE PUBLISH WE SELL **BOOKS** **on all Electrical Subjects**

Write for Catalogue. ELECTRICAL WORLD AND ENGINEER, 114 Liberty St., New York

WANTED a first-class "electrical machinist;" one having had a thorough knowledge on commutator building and repairs to same; steady work and good wages to right man. Address, No. 359, care Electrical World and Engineer, New York.

WANTED, by large company in New York City, a few mechanical draughtsmen. Special inducements to men who have had experience with telephone switchboards. Address, No. 360, Electrical World and Engineer, New York.

WANTED an electrical and mechanical engineer to take charge of a city lighting plant in Porto Rico. Knowledge of the Spanish language advisable. Salary, $150 per month. Answer stating positions held for past three years and any other references. Engineering Supervision Co., 35 Nassau Street, New York.

Agencies wanted by firm of electrical and mechanical engineers having a fine ground floor corner showroom in West Central district of London for the following: Steam, gas and oil engines, turbines, dynamos, motors, arc and incandescent lamps, hydraulic and pneumatic machinery, boilers, machine tools, measuring instruments, cables and wires, and any other electrical and mechanical machinery and specialties. Write "Box 676," Willings Offices, 125 Strand, London, Eng.

WANTED

In any town where the electric light company does not push the HYLO lamp, a salesman. The electrician and repair man under our plan can make money on the side introducing the HYLO. Write for particulars and state experience fully. We want good salesmen.

THE PHELPS COMPANY,
102 State Street,
DETROIT, MICH.

The first and most important point about advertising is to select the right medium.

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

FOR SALE.

110-125-VOLT INCANDESCENT DYNAMOS.

4—	12	Light,	Northern M. P., new.
1—	12	"	Northern M. P., compound.
1—	15	"	New Eng., self-oiler, comp.
1—	15	"	Towle, self-oiler.
1—	15	"	Westinghouse, multipolar.
1—	20	"	Northern, M. P., new comp.
1—	30	"	Northern, M. P., comp., s. o.
1—	35	"	Westinghouse, letter type, comp.
1—	35	"	Westinghouse, multipolar.
1—	35	"	Commercial, self-oiler.
1—	50	"	New Eng., self-oiler, comp.
1—	55	"	Card, M. P., self-oiler, enclosed type, slow-speed.
1—	55	"	Bullock, M. P., self-oiler, enclosed type.
1—	60	"	Detroit, comp., self-oiler.
1—	60	"	Mather, ring type.
1—	70	"	New England, comp.
1—	75	"	Kester, M. P.
1—	75	"	Westinghouse, M. P., self-oiler, comp.
1—	100	"	Queen City, self-oiler.
1—	100	"	Jenney, self-oiler.
1—	100	"	Eddy, self-oiler.
1—	100	"	Northern, multipolar, comp.
1—	100	"	New England, multipolar.
1—	100	"	Westinghouse, M. P., comp., s. o.
1—	120	"	Triumph, comp., self-oiler, M. P.
1—	110	"	Mather.
2—	110	"	Edison, comp., self-oiler.
1—	125	"	Crocker-Wheeler, self-oiler, comp.
1—	125	"	Fisher, multipolar, comp., direct connected.
1—	135	"	Gibbs, M. P., comp.
1—	150	"	Jenney, self-oiler.
1—	150	"	C. & C., self-oiler.
1—	150	"	General Electric, multipolar.
1—	160	"	Mather, self-oiler.
1—	160	"	Commercial, self-oiler.
1—	180	"	Westinghouse, self-oiler.
1—	190	"	Eddy, self-oiler, comp.
2—	210	"	Edison, self-oiler, comp., 12 W. W.
1—	225	"	Detroit.
1—	250	"	Commercial, comp., self-oiler.
1—	250	"	Eddy, self-oiler, comp.
1—	270	"	King, comp., self-oiler.
2—	270	"	Edison, 15 K. W., comp., s. o.
1—	300	"	Eickmeyer, new commutator.
2—	300	"	Jenney, self-oiler.
1—	300	"	Card, comp., self-oilers.
1—	300	"	Commercial, self-oiler.
1—	300	"	Bullock, M. P., comp., self-oiler.
1—	350	"	Light, Western Electric.
1—	350	"	Mather, comp., self-oiler.
1—	350	"	Duplex multipolar, self-oiler.
3—	400	"	Westinghouse, M. P., 22½ K. W.
1—	450	"	Rockford, self-oiler.
1—	500	"	Western Electric, comp., self-oiler.
1—	500	"	Jenney, comp., 30 K. W., s. o.
2—	500	"	Siemens & Halske, self-oilers.
2—	540	"	Edison, 30 K. W., self-oilers, comp.
3—	540	"	Mather, comp., self-oilers.
1—	700	"	Eddy, M. P., type G., self-oiler, comp., 40 K. W.
1—	800	"	Edison, 45 K. W., comp., self-oiler.
1—	900	"	Jenney, comp., self-oiler.
1—	900	"	Thomson-Houston, 50 K. W., comp., self-oiler.
2—1000		"	Edison, 60 K. W., comp., self-oilers.
1—1000		"	National, M. P., comp.
2—1200		"	Jantz & Leist, multipolar, comp., self-oilers, slow speed.
1—1200		"	General Electric, M. P., new 65 K. W.
1—1350		"	Waddel-Entz, 80 K. W., for direct connection, 8 pole.
1—1500		"	Keystone, multipolar, 80 K. W., comp.
1—1800		"	Triumph, multipolar, comp., 100 K. W.
1—1800		"	General Electric, 6 pole, comp., 100 K. W.

220-250-VOLT GENERATORS.

1—	6	K. W.	Westinghouse, multipolar.
1—	12	"	Edison, self-oiler.
1—	12	"	Eddy, self-oiler.
1—	12	"	Card, self-oiler.
1—	15	"	Edison, self-oiler.
2—	30	"	Edison, self-oilers, comp.
2—	60	"	Westinghouse, horizontal type.
1—	55	K.W.	Fuller, M. P., comp., self-oiler, slow speed.
1—	60	"	Siemens & Halske M. P., Churchward type, self-oiler, brand new, for direct con.
1—	62	"	Thomson-Houston, D 62, self-oiler, comp. wound.
1—120		"	Westinghouse, multipolar, comp.
1—125		"	Thompson-Ryan, comp., M. P.

500-550-VOLT GENERATORS.

1—	15	K.W.	T-H., D. 15, self-oiler.
1—	33	"	Wood, M. P., self-oiler, 6 pole, steel frame.
1—	35	"	C. & C., self-oiler.
1—	35	"	Bullock, M. P., slow speed.
5—	45	"	Edison, comp., self-oilers.
1—	60	"	Wood, speed 1200.
1—	60	"	Edison, self-oiler, comp.
1—	62	"	Thomson-Houston, s. o., D. 62.
3—	90	"	General Electric, M. P., 90, self-oilers, comp.

ALTERNATING GENERATORS

125-140 Cycles.

1—	200-light		Ft. Wayne, self-oiler.
1—	300	"	La Roche, 1100 volts, two phase, self-oiler.
1—	350	"	Slattery, self-oiler, 1100 volts.
1—	500	"	National, 1100 volts.
1—	600	"	Thomson-Houston, 30 K. W., 1100 volts, self-oiler.
3—	600	"	Westinghouse, 30 K. W., self-oiler.
3—	600	"	Westinghouse, 30 K. W., toothed armature, alternations, 1100 volts, composite field.
3—	600	"	General Electric, A 30, toothed armature, compound wound, 1100 volts, self-oiler.
2—	650	Light.	Thomson-Houston, A. 35, self-oilers, 1100 volts, composite wound.
3—	650	"	Wood, 33 K. W., self-oilers, composite wound, toothed armature, 1100 volts.
1—	750	"	Westinghouse, self-oiler, 37½ K. W.
1—	750	"	Brush, self-oiler, toothed armature, 1100 volts.
1—	750	"	Wood, 37½ K. W., self-oiler, toothed armature, 1100 volts, composite wound.
1—	750	"	Wood, same as above, 2200 volts, with new armature.
1—	800	"	Standard, 40 K. W., inductor type, 1100 volts.
1—	800	"	Gregory Electric Co., reconstructed Standard, 40 K. W., new form B., slotted armature, 1100 volts.
2—	900	"	Westinghouse, 45 K. W., self-oiler, composite wound, toothed armature.
1—	900	"	Westinghouse, 45 K. W., self-oiler, 1100 or 2200 volts, composite wound. toothed arm.
2—1000		"	Wood, 50 K. W., self-oiler, 1100 volts, toothed arm, latest type, composite wound.
1—1200		"	Gregory Electric Co., reconstructed Westinghouse, 60 K. W., self-oiler, with new form B, latest type, slotted armature, distributed multicoil winding. Either 1100 or 2200 volts.
1—1200		"	Gregory Electric Co., reconstructed Slattery, 60 K. W., compound, self-oiler, 1100 volts, with new form B slotted armature, latest type.
1—1200		"	Gregory Electric Co., reconstructed T-H., 60 K. W., composite wound, self-oiler, with new form B slotted armature, latest type, single phase. Either 1100 or 2200 volts.
2—1200		"	Westinghouse, 60 K. W., self-oiler, 1100 volts, composite wound, toothed armature.
2—1200		"	General Electric, A 60, 1100 volts, composite wound, toothed armature, self-oilers, complete with exciter.
1—1200		"	General Electric, same as above, 2200 volts.

DYNAMOS MONEY SAVERS ENGINES

ENGINES.

1—30x48x48 Allis cross compound.
1—28x48x60 Cooper Corliss.
1—22x40x48 Cross Compound Wright.
1—24x42x36 tandem Compound Wright.
1—15¼x28½x30 tandem Compound Buckeye, new.
2—13x27x17 McI. & S. compound.
1—15x25x17 Ball cross compound.
1—13x24x18 Armington & Simms.
1—14x28x27 Phœnix cross compound.
1—16x27x16 Westinghouse compound.
2—15x25x14 Ball cross compound.
1—11x19x15 McI. & S. compound.
2—11x19x11 Westinghouse compound.
1—8x14½x10½ McI. & S. compound.
1—9x16x14 McEwen.
1—40x48 Weatherill-Corliss.
1—24x48 Watts-Campbell Corliss.
1—18x36 Watts-Campbell Corliss.
1—18x42 Wright Corliss.
1—16x42 Green Corliss.
1—20x42 Harris Corliss.
1—28x60 Brown Corliss.
1—14x18 Ames slide valve.
1—16x16 Ball automatic.
2—13x12 New York Safety.
2—12x12 Armington & Sims.
1—14x14 Armington & Sims.
5—7½x7 Westinghouse automatic.
Hill automatic engines 3-20 H.P. inclusive, new.

BOILERS.

4—375 H.P. National Watertube.
1—250 " Sterling Watertube.
1—250 " Heine watertube.
3—250 " Cahill vertical Watertube.
3—200 " Campbell & Zeld Watertube.
2—136 " each B. & W. Watertube.
1—100 " B. & W. Watertube.
6—125 " Horizontal tubular.
4—100 " Horizontal tubular.
2— 80 " Horizontal tubular.
2— 50 " Horizontal tubular.

500-550 VOLT APPARATUS.

2—500 K. W. General Electric M. P.
2—500 " Westinghouse M. P.
3—400 " Walker M. P.
1—270 " General Electric M. P.
1—200 " General Electric M. P.
8—100 " General Electric M. P.
2— 75 " Mather M. P.
2— 75 " Westinghouse M. P.
3—100 " Edison bi-polar.
3— 90 " Thomson-Houston M. P.
5 D—62 Thomson-Houston M. P.
1— 60 K. W. Edison bi-polar.
3— 45 " Edison bi-polar.
3— 25 " Edison bi-polar.

We have a full stock of 500-550 volt motors in stock, ranging from 1 H.P. up to 125 H.P. inclusive.

220-VOLT APPARATUS.

2—100 K. W. Edison bi-polar.
1— 75 " General Electric M. P.
1— 45 " Edison bi-polar.
1— 40 " Thomson-Houston.
1— 30 " Edison bi-polar.
1— 25 " Edison bi-polar.

We have a full stock of 220-volt motors ranging from ½-H. P. up to 125-H. P., inclusive.

110-VOLT APPARATUS.

2—1500 light Westinghouse M. P.
2—1430 " Edison bi-polar.
3— 100 " Edison.
2— 900 " Wenstrom M. P.
1— 600 " Loomis M. P.
3— 840 " Edison bi-polar.
2— 300 " Edison bi-polar.
1— 400 " Loomis self-oiling.
4— 360 " Thomson-Houston S. O.
1— 225 " C. & C.
1— 150 " C. & C.
1— 120 light Electro Dynamic.
1— 100 " Edison bi-polar.
1— 60 " Edison "

We have a full stock of 110 volt motors ranging from ½-H. P. up to 125-H. P., inclusive.

DIRECT CONNECTED SETS.

1—75 K. W. Bullock 220 volts, coupled to compound Ideal engine, new.
2—50-K. W. Walker M. P. 110 volts, coupled to Russell engine (new).
1—50-K. W. Westinghouse M. P. 250 volts coupled to Buckeye engine.
1—25-K. W. Walker M. P. 110 volts, coupled to Russell engine (new).
1—16-K. W. G. E. M. P. 110 volts, coupled to 25-H. P. Case engine.
1—5-K. W. Perrett 110 volts, coupled to Case engine.
1—3½-K. W. Northern 110 volts, coupled to Thompson engine.

ALTERNATING CURRENT MOTORS.

1—1½-H. P. Emerson 104 volts 133 cycle.
1—3-H. P. 133 cycle 2 phase 550 volt Stanley.
1—5-H. P. 133 cycle 2 phase 550 volt Stanley.
1—7½-H. P. 133 cycle 2 phase 550 volt Stanley.
1—15-H. P. 133 cycle 2 phase 550 volt Stanley.
1—25-H. P. 133 cycle 2 phase 550 volt Stanley.
1—20-H. P. 60 cycle G. E. 200 volt 2 phase induction motor.
1—100-H. P. 25 cycle 360 volts 3 phase Westinghouse type C induction.
1—200-H P. 25 cycle 2 phase 400 volts 25 cycle Westinghouse type C.
1—5-H. P. Ft. Wayne single phase 104 volts 125 cycle.
1—10-H. P. Excelsior 60 cycle 100 volts Synchronous type.

ALTERNATORS.

2—25-K. W. Westinghouse 125 cycle 2000 v.
1—30-K. W. Wood 60 cycle 1100 v.
1—33-K. W. Westinghouse 60 cycle 1100 v.
2—30-K. W. Westinghouse 133 cycle 1100 v.
1—45-K. W. Westinghouse 133 cycle 1100 v.
2—60-K. W. Stanley 60 cycle 1000-2000 v.
4—60-G. E. 133 cycle 1100-2000 v.
2—75-K. W. Westinghouse 1000-2000 v.
2—75-K. W. West. 60 cycle 3 phase
3—120-K. W. West. 125 cycle 1000-2000 volts.
2000 volts.
4—120-K. W. G. E. 125 cycle 1100-2000 volts.
1—150-K. W. Ft. Wayne 125 cycle 1100 v.
2—250-K. W. 60 cycle 3 phase G. E. 10000 v.

ARMATURES.

1—7½-H.P. Crocker-Wheeler, 250 volts.
1— 15-K.W. Edison bi-polar, 125 volts.
1— 30 " Edison bi-polar, 300 volts.
1— 30 " Edison bi-polar, 125 volts.
1— 80 " Detroit bi-polar, new.
4—100 " Edison bi-polar, 125, 250, and 500 volts.
1—750-Light Westinghouse, 1000 volts, new.

ARC DYNAMOS. ARC LAMPS. METERS. TRANSFORME

THOMPSON SON & CO.
HEAD OFFICE
114 LIBERTY ST N.Y.

BOILERS EQUIPMENTS

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO.

ALL MACHINES IN STOCK AT OUR WAREHOUSE.

Large stock of Meters, Arc Lamps, Station Instruments and Supplies. All apparatus fully guaranteed in perfect operative condition. Send for Monthly Bargain Sheet with complete list and net prices.

ALTERNATING GENERATORS.
125-140 Cycle.

1—1200-Light. Stanley, inductor type, 1100
1—1200 " Stanley, inductor type, 1100 or 2200 volts, two phase, 60 K. W.
1—1300 " Slattery, 70 K. W., self-oiler, 1100 or 2200 volts, complete with exciter.
2—1300 " T-H, A 70, 1100 or 2200 volts, self-oiler, compound wound.
1—1500 " Westinghouse, 75 K. W., 1100 volts.
1—1800 " Standard, 90 K. W., inductor type, 2200 volts.
2—1500 " Wood, 75 K. W., self-oilers, comp., 1100 volts, toothed armature.
3—1500 " Wood, 75 K. W., self-oilers, comp., 2200 volts, toothed armature.
1—1800 " Westinghouse, 90 K. W., self-oiler, composite wound, toothed armature, 1100 volts.
1—2400 " Gregory Electric Co., reconstructed T-H., 120 K. W., composite wound, self-oiler, new form B armature. Either 1100 or 2200 volts.
4—2400 " General Electric, 120 K. W., 1100 volts, self-oilers, toothed armature, composite wound.
1—2400 " Westinghouse, 120 K. W., composite wound, 2200 volts, toothed armature, self-oiler.
2—3000 " General Electric, 150 K. W., monocyclic, 1100 volts, toothed armature, composite wound, self-oilers.
1—4000 " Stanley, inductor type, 200 K. W., 2200 volts, self-oiler, 2 phase.
1—8000 " Westinghouse, 400 K. W., slotted armature, 1100 volts, three bearings, self-oiler, distributed winding.

ALTERNATING GENERATORS.
60 Cycle.

1— 300-light Westinghouse, 15 K. W., comp., self-oiler, 1100 volts, toothed armature.
1— 500 " Westinghouse, 25 K. W., 1100 volts, 60 cycle, composite wound, toothed armature, self-oiler.

1—1200-Light. Siemens & Halske. 60 K.W self-oiler, single phase, inductor type, 1100 or 2200 volts.
1—1200 " 60 K. W., Siemens & Halske, latest Churchward type, brand new, 60 cycle, single phase, 1100 volts, multicoil distributed winding, slotted armature.
1—1500 " Warren-Medberry, 75 K. W., 1100 or 2000 volts, single phase, inductor type, 60 cycle, new.
1—1500 " Warren-Medberry, 1100 or 2200 volts, 75 K. W., 60 cycle, self-oiler, two phase inductor type.
2—1500 " Westinghouse, 1100 volts, 60 cycle, 75 K. W., toothed armature, composite wound, self-oiler.
1—1500 " General Electric, monocyclic, 75 K. W., self-oiler, 1100 volts.

ROTARY TRANSFORMERS.

Booster Sets and Motor Generators.

1—¼ H. P. Western motor-generator, self-oiler, 110 to 10 volts, direct current, new.
1—Crocker-Wheeler, 220 volts d. c. to 55 volts a. c., 5 H. P.
1—Westinghouse, 400 volts alternating current 60 cycle, two phase, to 500 volts direct, 37½ K. W., with transformers and switchboard complete.
1—Siemens & Halske, brand new, Churchward type, M. P., rotary transformer, 60 cycle, two phase, 175 volts alt. to 250 volts direct, with marble panel switchboard, all complete, 60 K. W.

ARC DYNAMOS.

1— 30-light 2000 C.P. T.-H., M. 2.
1— 30 " 2000 " T.-H., M. 2 ring armature, self-oiler.
1— 35 " 2000 " T.-H., L D 2, ring armature.
2— 45 " 1200 " T.-H., M. 12 new ring armature.
1— 45 " 1200 " Brush No. 7 with latest improved Steuben rausch commutator.
2— 50 " 2000 " T.-H., M. D. 2.
1— 50 " 2000 " T.H., M. D. 2, new ball.
2— 50 " 2000 " T.-H., M. D. 2, ring armature.
1— 50 " 2000 " T.H., M. D. 2, new ring.
1— 65 " 2000 " Brush No. 8, with new armature, with Steuben rausch fire-proof commutator.
1— 65 " 1200 " Westinghouse, multipolar, self-oiler complete with exciter.
1— 75 " 1200 " Wood with new armature.
2—125 " 1200 " Excelsior, latest type

ALTERNATING CURRENT MOTORS.

1—Light. ⅛H.P. Holtzer-Cabot, 52 volts, 133 Single Phase. cycle, induction.
1— ¼ " Holtzer-Cabot, 104 volts, 133 cycle induction.
1— ¼ " Stanley, 110 volts, 133 cycle.
1— ⅓ " Holtzer-Cabot, 110 volts, 125-133 cycle, self-oiler.
2— ½ Stanley, 104 volts, 133 cycle.
1— ¾ " Emerson, 125-133 cycle, self-oiler, 104 volts.
1— 1 " Ft. Wayne, 125-133 cycle, 104-110 volts.
1— 1 " Emerson 125 cycle, 104 volts.
2— 1½ " Wagner, 125-133 cycle, 104 volts.
1— 2 " Wagner, 133 cycle, 104 volts.
1— 2½ " Ft. Wayne, 125 to 133 cycle, 110 volts.
1— 7½ " Wagner, 125 to 133 cycle, 104 volts.
1— 10 " Ft. Wayne, 110 volts, 60 cycle.

Two Phase. Stanley.
133 Cycle. 500 Volts.

9— 1 H. P.
1— 2 " with condenser.
1— 3 " with condenser.
3— 5 " with condenser.
1— 7 " with condenser.

Two Phase. Westinghouse.
60 Cycle.

1— 1 H. P. Westinghouse, type C. 200 volts.
2— 10 " Westinghouse, type B, 400 volts.
1— 10 " General Electric, 110 volts.

Three Phase. General Electric.
60 Cycle.

1— 3 H. P. 220 volts.

BATTERY MOTORS.

1— 3 amp. Elbridge for sparking gas engine, 15 volts, M. P., self-oiler.
1— ½H. P. Ft. Wayne, self-oiler, 40 amp., 10 volts.

Charles E. Dustin Company,

ELECTRICAL AND STEAM MACHINERY.

Fully Guaranteed. We Advertise Only What We Own.

1—500 K.W., M.P. 4 G.E. Generator, 500 volts.
1—300 K.W., M.P. 4 " " "
1—270 K.W., M.P. 4 " " "
3—200 K.W., M.P. 4 " " "
2—175 K.W., Edison Bipolar " "
2—110 K.W., Eddy Generator, 500 volts.
1—100 K.W., Walker " "
2—100 K.W., General Electric, "
1—100 K.W., Edison Bipolar, "
2—80 K.W., Detroit Bipolar, "
1—100 K.W., Mather, "
4—D62 T.-H., 500 volts.

DIRECT CURRENT 110-125 and 220 volt APPARATUS

EDISON BIPOLARS 60 to 150 K.W.,
GENERAL ELECTRIC M.P., 30 to 100 K.W.,
WESTINGHOUSE, 50, 75, 100 and 150 K.W.,
and Smaller Sizes.

ARC MACHINES:

BRUSH, 30 to 125 lights,
THOMSON-HOUSTON, M2 and LD 12, M12.
EXCELSIOR, 80 lights,
FORT WAYNE, 100 lights,
and others.

ALTERNATING CURRENT, SINGLE, TWO and THREE PHASE, 60 and 120 CYCLES

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Also, one compound wound generator, 180 kw, 7,200 alternations, 1,150 volts and 200 R.P.M., same to be direct connected to above engine.

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Ely, Minn., June 12th, 1902.

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1 16x16 Frie Ball Engine
1 15½x15 Armington & Sims Engine
1 14x13 Armington & Sims Engine
2 12x12 New York Safety Engine
3 15x25x16 Frie Ball Engine, Cross Compound
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CITY CLERK'S OFFICE,
NEW CASTLE, PA., June 17, 1902.

Sealed proposals will be received at this office until 7.30 P. M. of Monday, July 14, 1902, for the construction of a Public Conduit System in the city of New Castle.

Plans and specifications may be seen at the office of the City Engineer.

Each proposal to be accompanied by a deposit of $500.00 in cash or a certified check and addressed to the undersigned, and marked "Proposals for Conduit System."

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1—300-kw. General Electric, M. P.
3—225-kw. General Electric, M. P.
2—200-kw. General Electric, M. P.
2—150-kw. Westinghouse, M. P.
4—100-kw. General Electric, M. P.
2—100-H.P. Westinghouse, M. P.
1—120-kw Westinghouse, M. P.
3— 60-kw. Edison, Bipolar, M. P.
2—75-kw. Thomson-Houston.
1—D62 Thomson-Houston.

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1—25-H.P. C. & C.
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1—15-H. P. Crocker-Wheeler.
1—15-H.P. T.-H.
1—20-H.P. Westinghouse.
1—12-H.P. C. & C.
1—20-H.P. C. & C.
1—12-kw Edison.
1—12-H.P. Jenney.
1—10-H.P. Mather.
1—10-H.P. Crocker-Wheeler.
1—10-H.P. C. &. C.
1—10-H.P. T.-H.
1—7½-H.P. Card.
1—7½-H.P. C. & C.
1—10-H.P. General Electric.
1—5-H.P. C. &. C.
1—5-H.P. T.-H.
1—5-H.P. Eddy.
1—5-H.P. Westinghouse.
1—3-H.P. General Electric.
1—3-H.P. Belknap.
1—3-H.P. Crocker-Wheeler.
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1—2-H.P. General Electric.
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1—56-kw Westinghouse M. P.
1—D62-kw Thomson-Houston.
1—D20-kw Thomson-Houston.
1—35-H.P. C. & C.
1—25-H.P. C. & C.
1—25-H.P. Eddy.
1—15-H.P. Perret.
1—15-H.P. Excelsior.
1—12-H.P. C. & C.
1—10-H.P. Thomson-Houston.
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1—30-H.P. U. S.
1— 30-H.P. Westinghouse M. P.
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1—15-H.P. Mather.
1—10-H.P. M. P. Excelsior.
1—10-H.P. Bipolar Excelsior.
1— 5-H.P. Thomson-Houston.
1—25-amp. Westinghouse.
5—1¼-H.P. M. P. Excelsior.
1—10-amp. Westinghouse.
1—3-kw Mather.
1—21-amp. Ft. Wayne.
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1—300-kw General Electric, 1100 volts, 120 cycle, 682 R. P. M.
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1—120-kw Westinghouse, 1100 volts, 16,000 alternations, toothed arm.
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1—45-kw Westinghouse, 2200 volts, 7200 alternations.
1—45-kw Westinghouse, 1100 volts, 7200 alternations.
2—A35 General Electric, single-phase, 16,000 alternations, 1050 volts.
2—A30 General Electric, single-phase, 16,000 alternations, 1050 volts.
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1—120-kw General Electric, 2-phase, 60-cycle, 2200 volt.
1—75-kw Stanley 2000-1000 volts, 2-phase, 16,000 alternations.
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1—75-kw Westinghouse, 2-phase, 60 cycle, 2200 volts.
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May 24th issue, and was the most complete report published in any paper.

The report of the Annual Convention of the American Institute of Electrical Engineers, held at Great Barrington, June 17-21, appeared in the issue of June 21.

The National Independent Telephone Convention was held this week, June 24 to 26 inclusive, and the report is in this issue.

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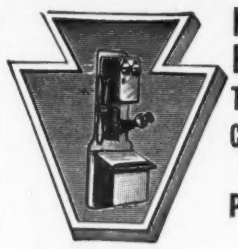

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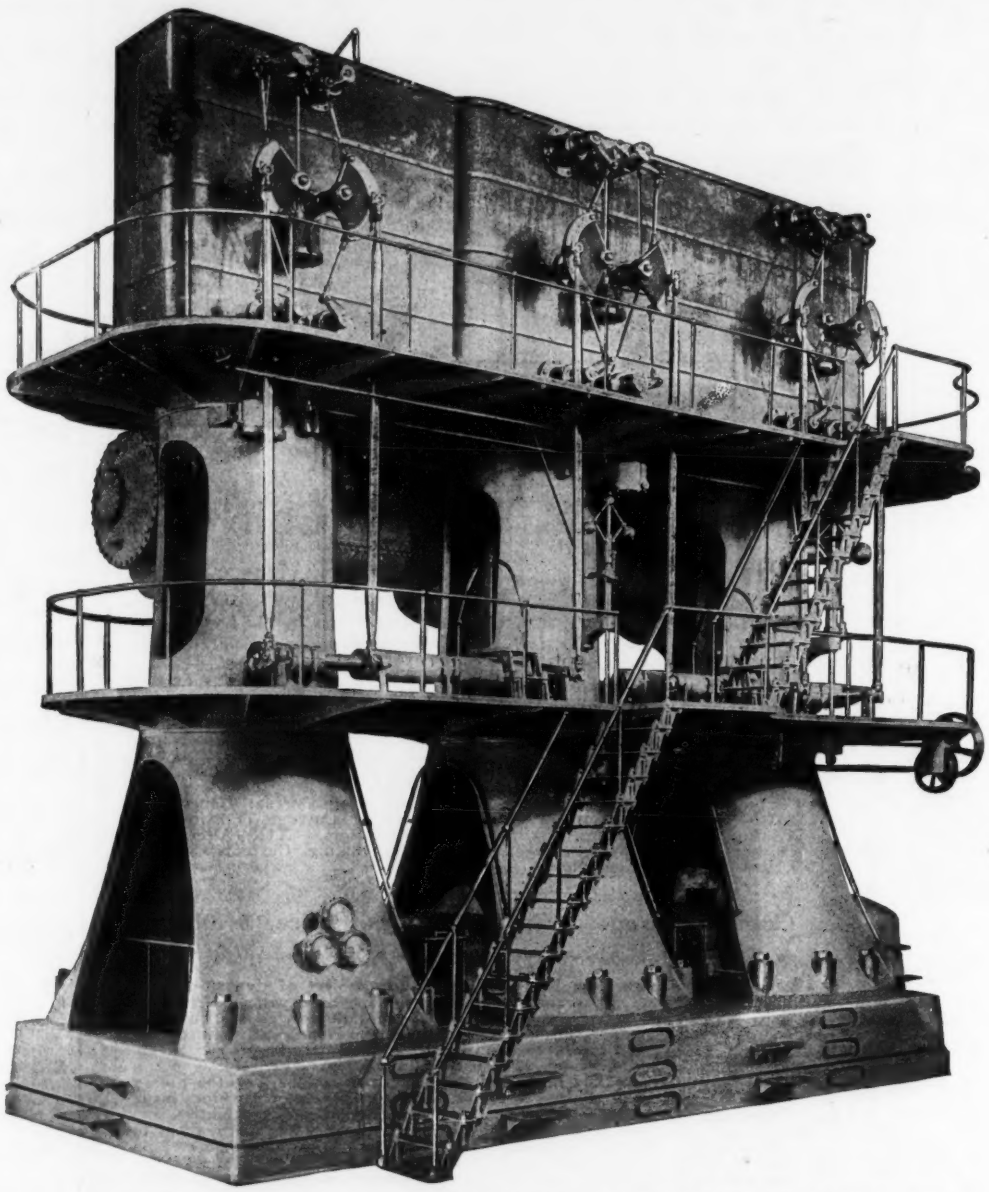

The above illustration shows a view of a Reynolds Vertical Three-Cylinder Compound Condensing Engine of 4,000 hp. capacity. Two of these engines were furnished the Glasgow Corporation Tramways, Glasgow, Scotland.

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Quote No. X.

May 15th, 1902.

EDWIN REYNOLDS, ESQ.,
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DEAR SIR:—

Having regard to the great amount of discussion there has been in this country as to the design and merits of the two 4,000 H.-P. engines which you supplied to the Tramways Department of the Glasgow Corporation, you will, I think, be interested to know that they have been tested by Prof. Barr, a disinterested expert, and found to give exceptionally good results. The consumption of steam per I. H.-P. as measured by the condensed water was found to be 12.2, and the mechanical efficiency of the engines 96 per cent. Your engines are direct connected to G. E. 2,500 K. W. triphase machines, and the combined efficiency, that is the ratio of the I. H.-P. to the E. H.-P. output, was 92 per cent. The engines are working perfectly well in all respects, and have been from the beginning.

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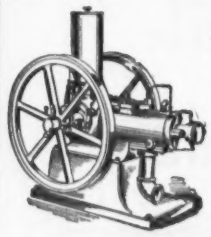

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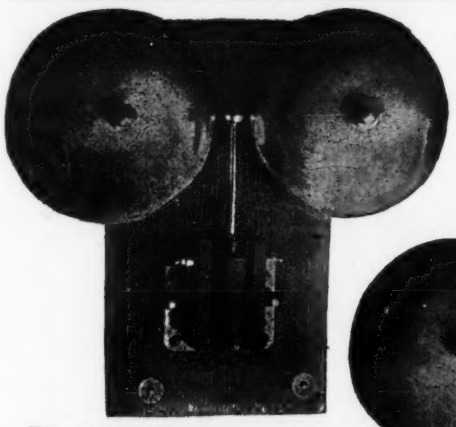

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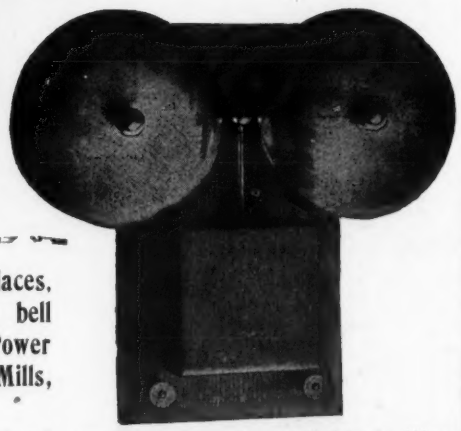

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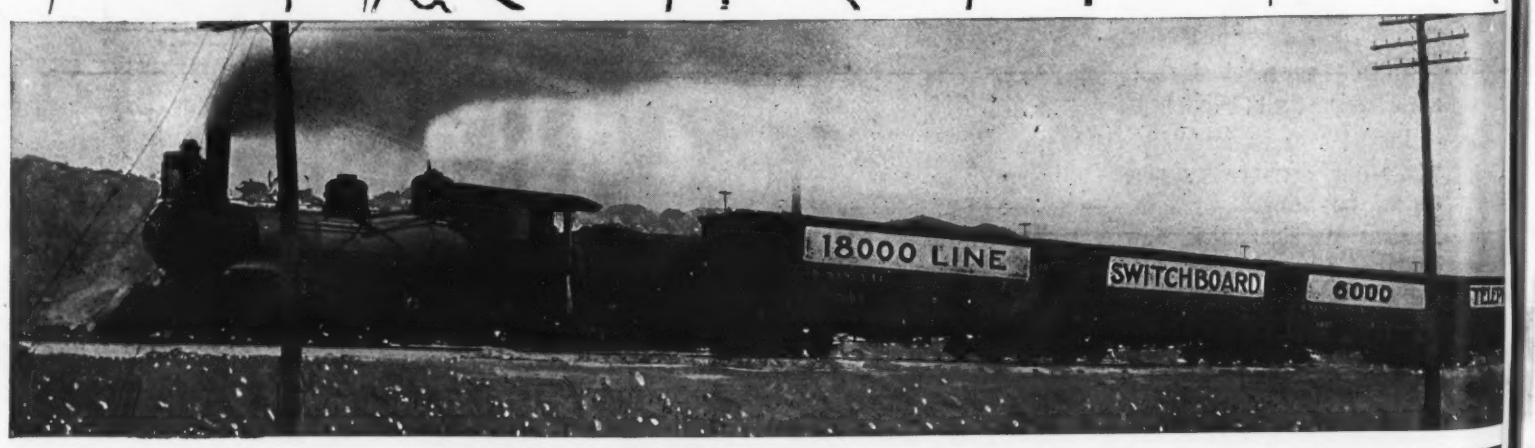

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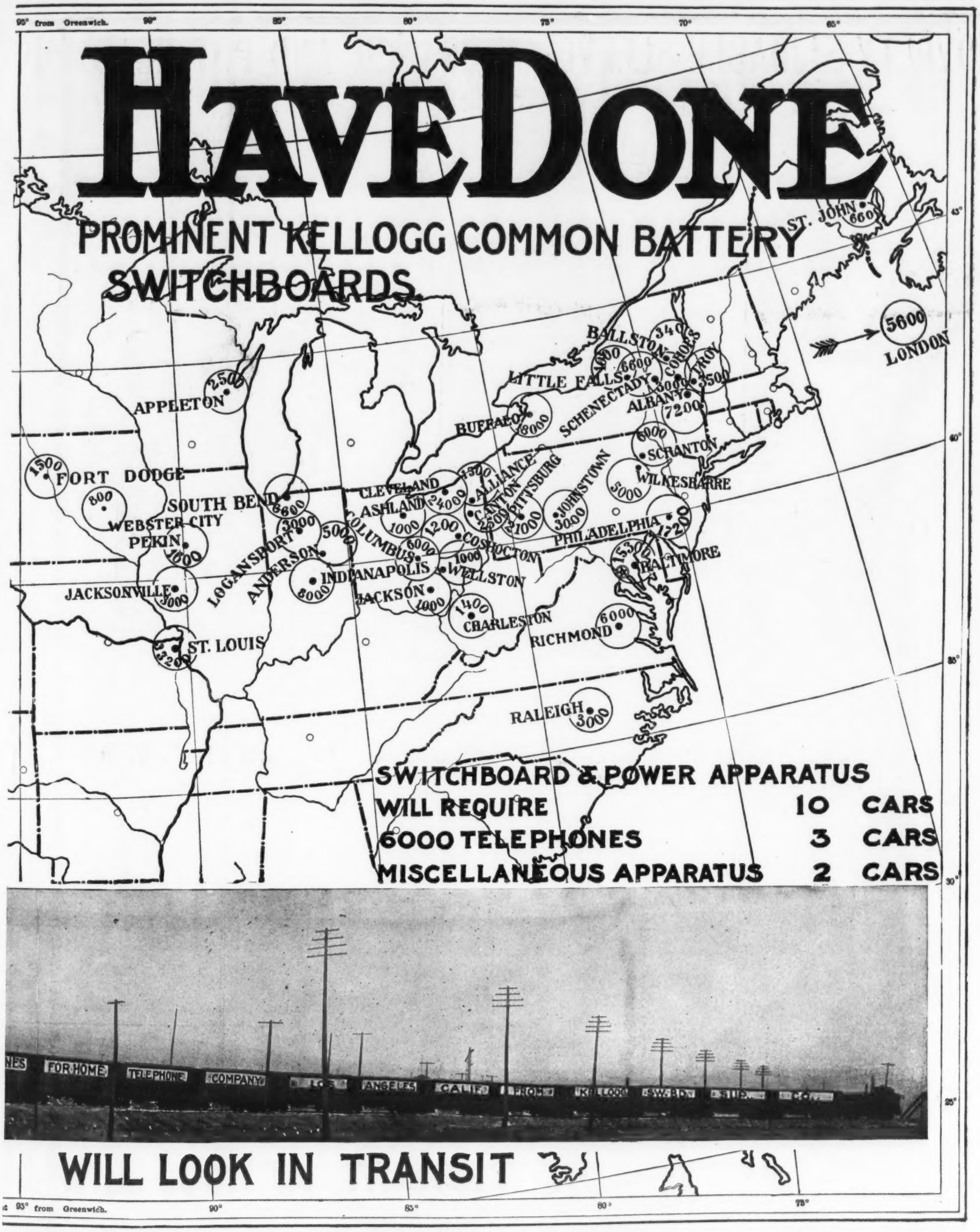

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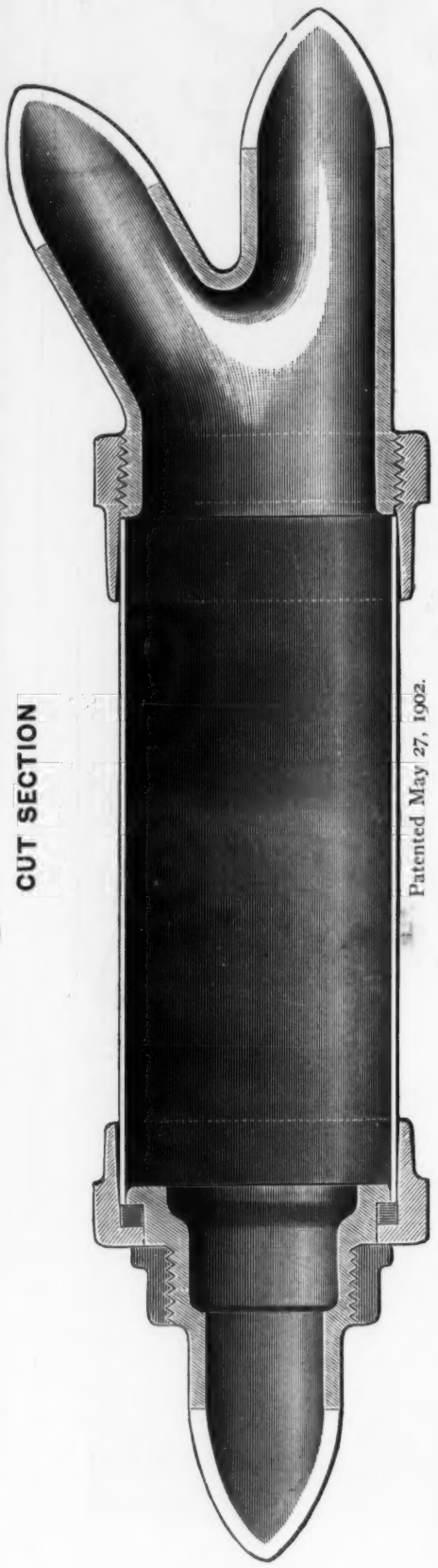

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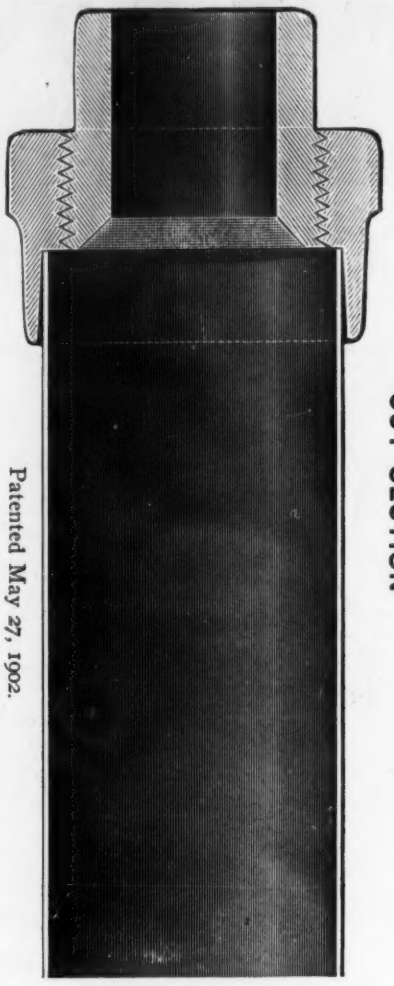

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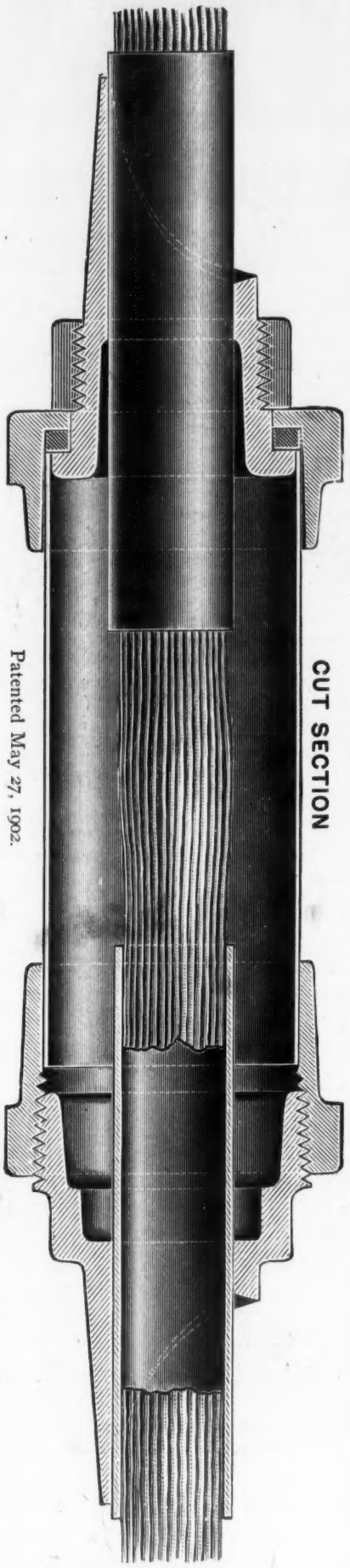

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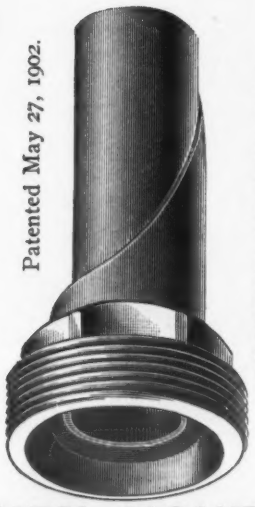

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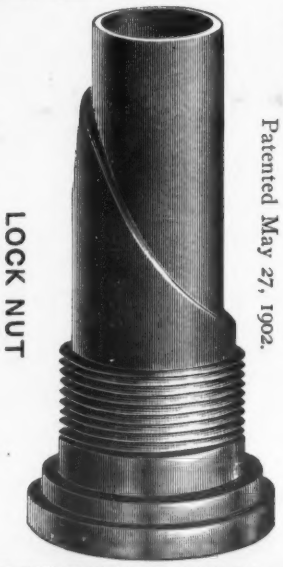

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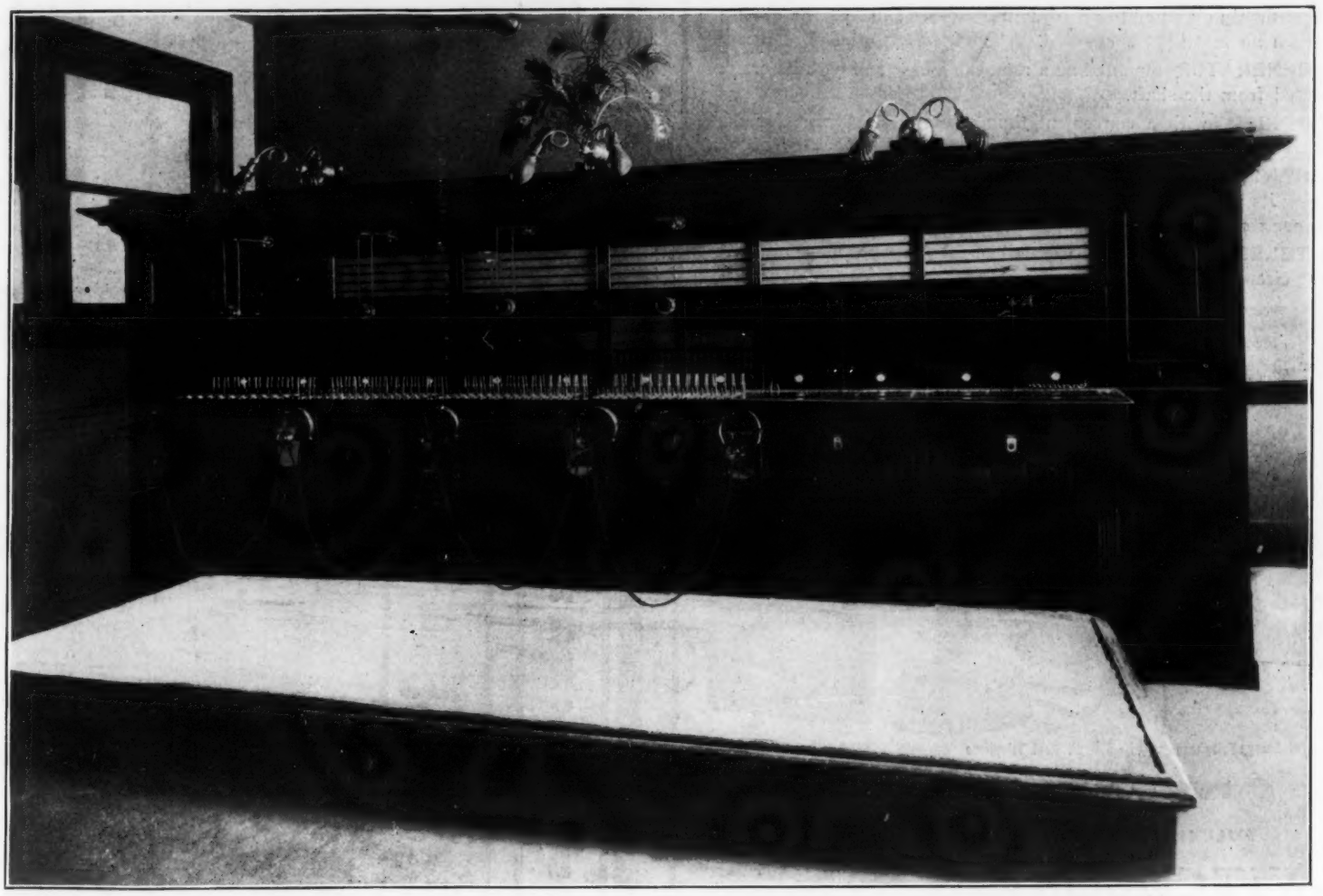

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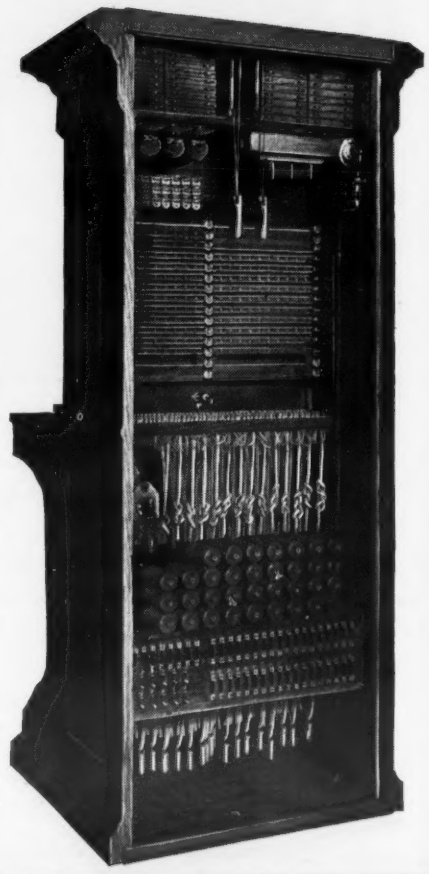
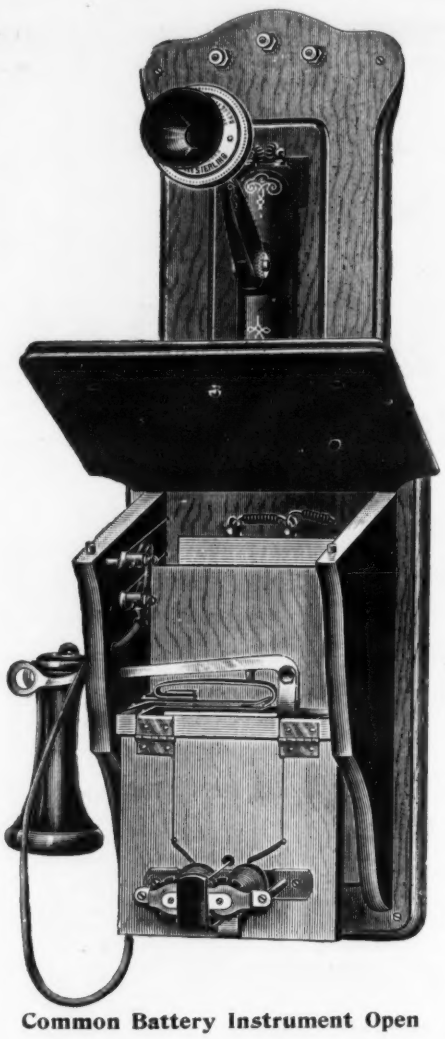


Sterling Electric Co.

Multiple Common Battery Switchboards



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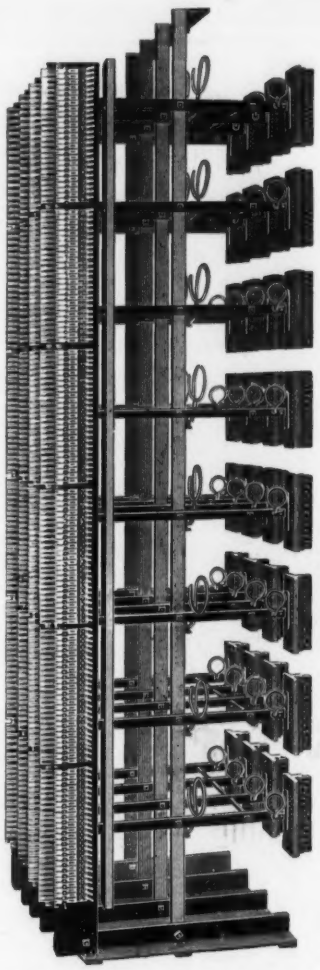
Houston, Texas	3,000
Rockford, Ills.	1,600
Lima, Ohio	1,500
Wichita, Kans.	1,500
Galesburg, Ills.	1,200
Marion, Ohio	1,050
Lorain, Ohio	1,050
Peru, Ind.	750
Joplin, Mo.	1,500



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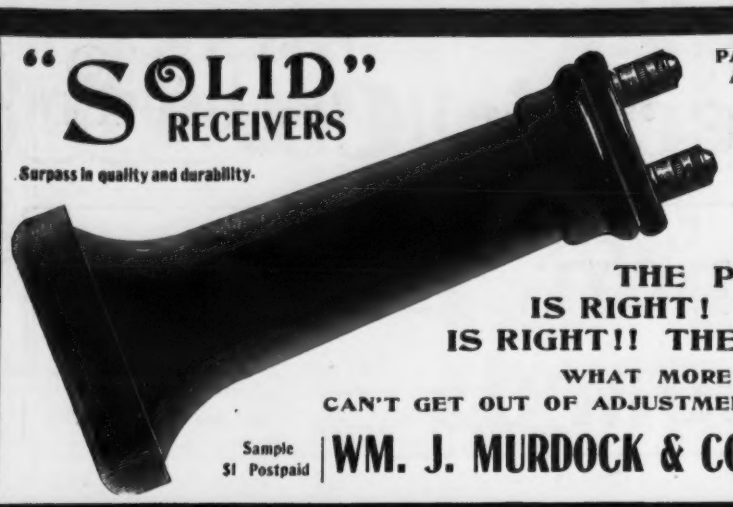

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DO NOT put money in until told to do so by operator.
Call exchange in regular manner.
When told by operator insert coin in slot, ONE COIN at a time, pull lever way down for each coin inserted, then let go.
Keep receiver off hook.
TEL. No.

This Pay Station

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No. 508. Key Handle.

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No. 602. Cap for Watch Case Receiver.

No. 519. Watch Case Receiver.

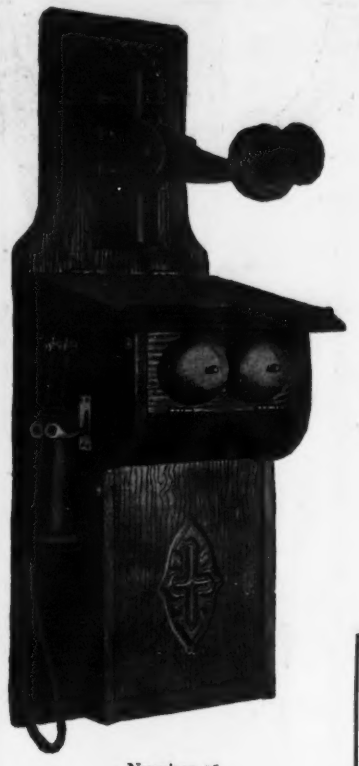
No. 702. Transmitter Cup.

No. 728. Crank Handle.

No. 506. Crank Handle.

No. 507. Knob and Key Handle.

TELEPHONES FOR USE ON MAGNETO SYSTEMS



Number 15.

THEY ARE SO CONSTRUCTED THAT THE UPPER LID CAN BE RAISED; THE FRONT, ON WHICH IS MOUNTED THE RINGER AND GONGS, CAN BE LOWERED OR OPENED, and THE BATTERY BOX IS ALSO SUPPLIED WITH A DOOR SO THAT THE BATTERIES ARE ACCESSIBLE WITH VERY LITTLE TROUBLE. THE INSTRUMENT IS ESPECIALLY ADAPTED TO RESIDENCE WORK ON ACCOUNT OF ITS HANDSOME FINISH. WRITE US FOR PARTICULARS

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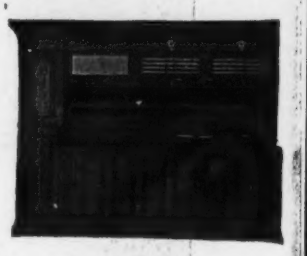

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COMPLETE NON-INFRINGING GUARANTEED
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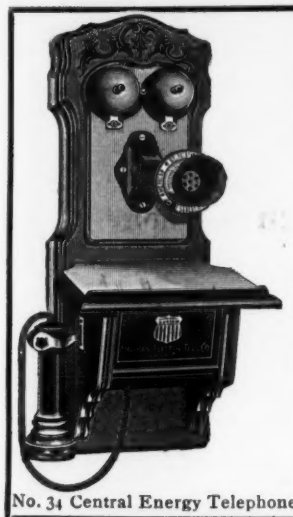

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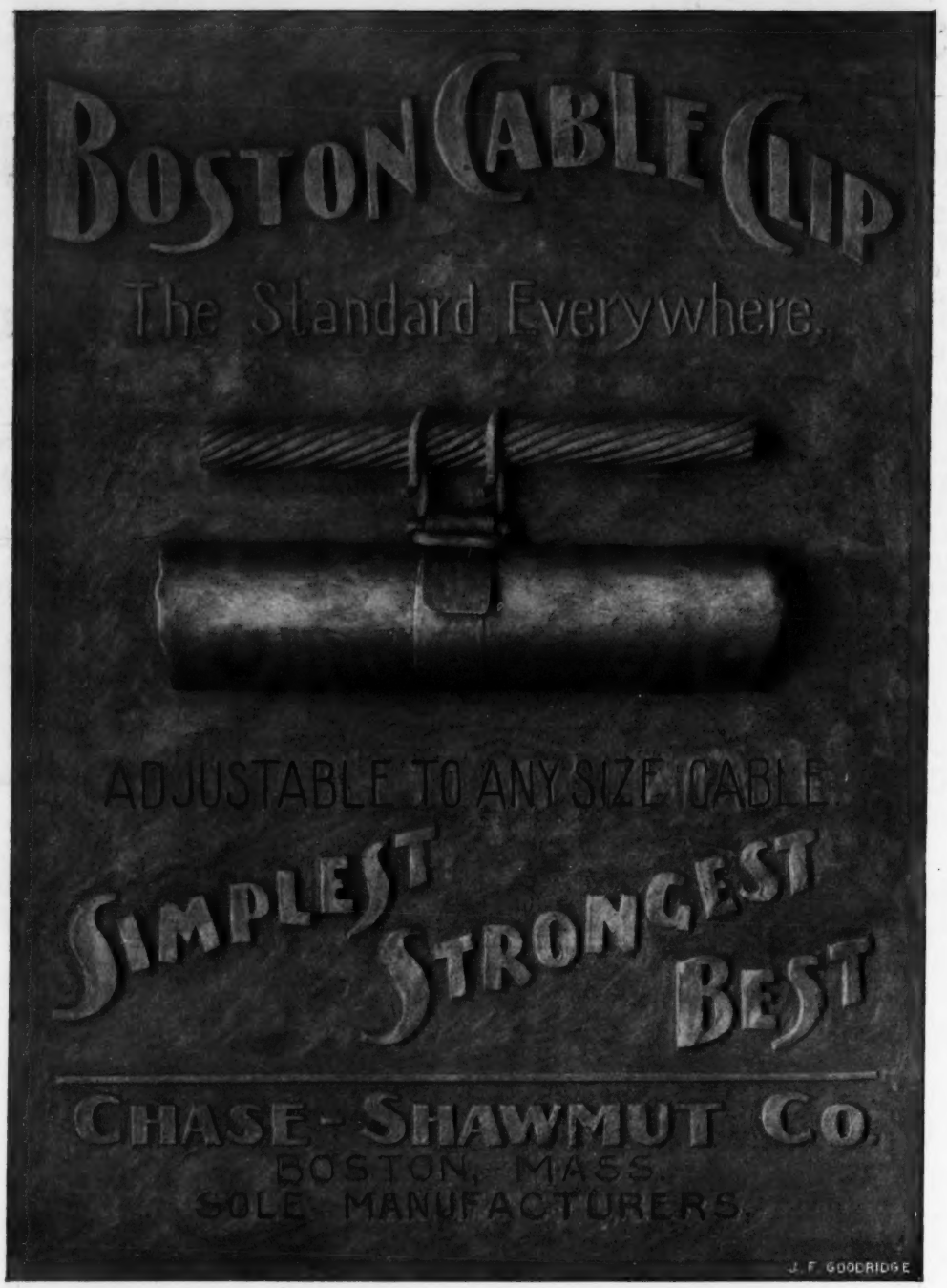

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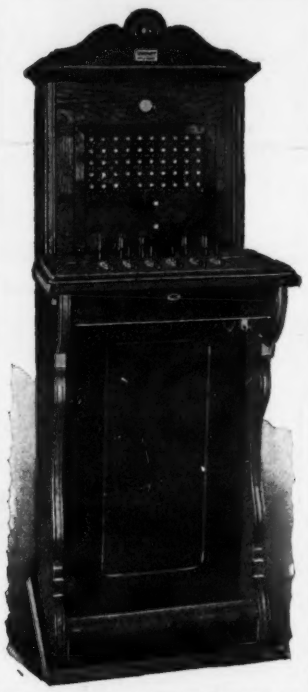

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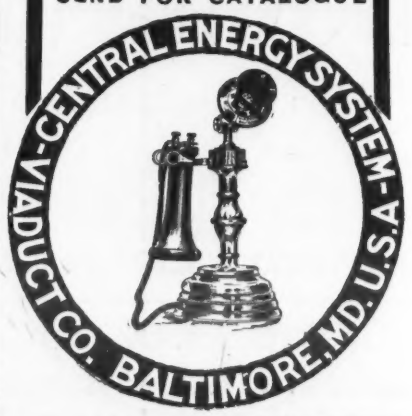

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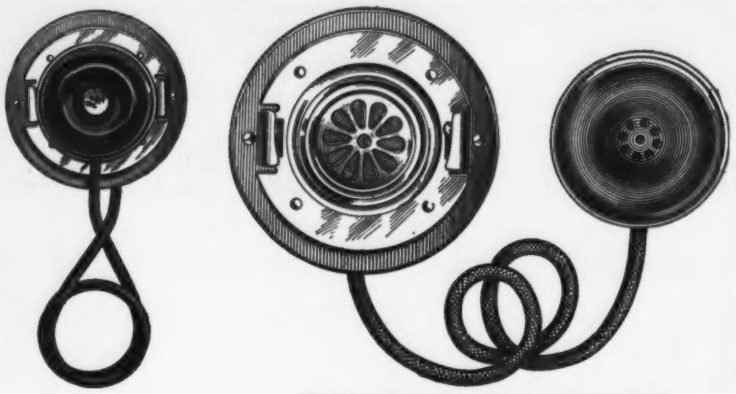

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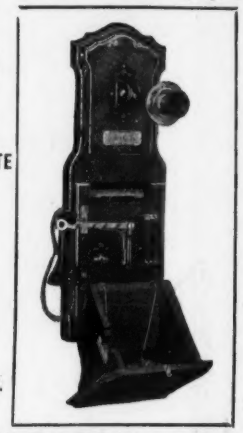

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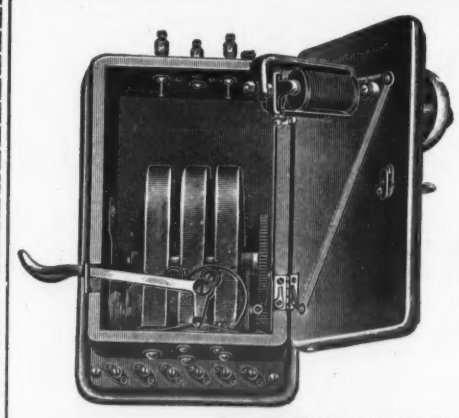

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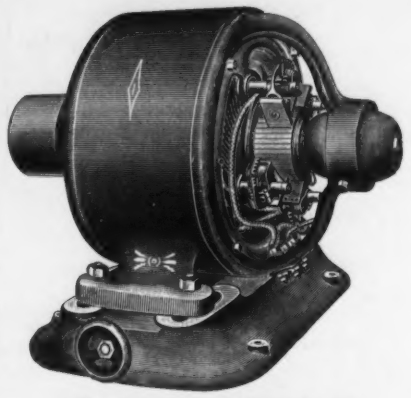

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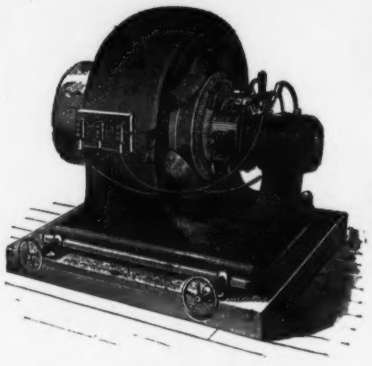

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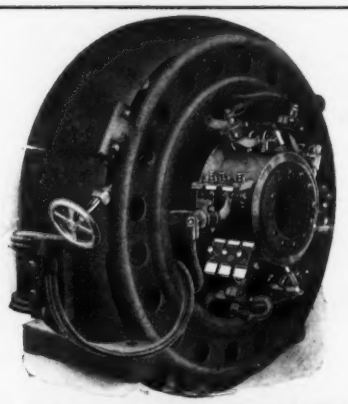

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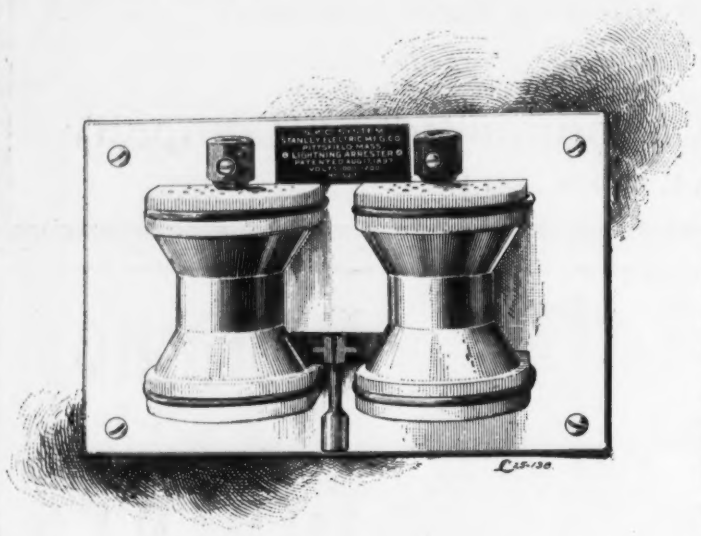

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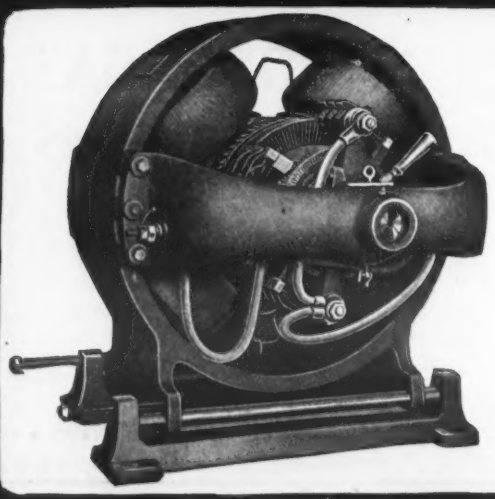

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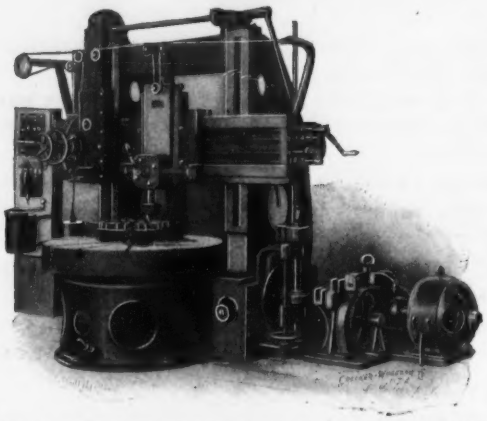

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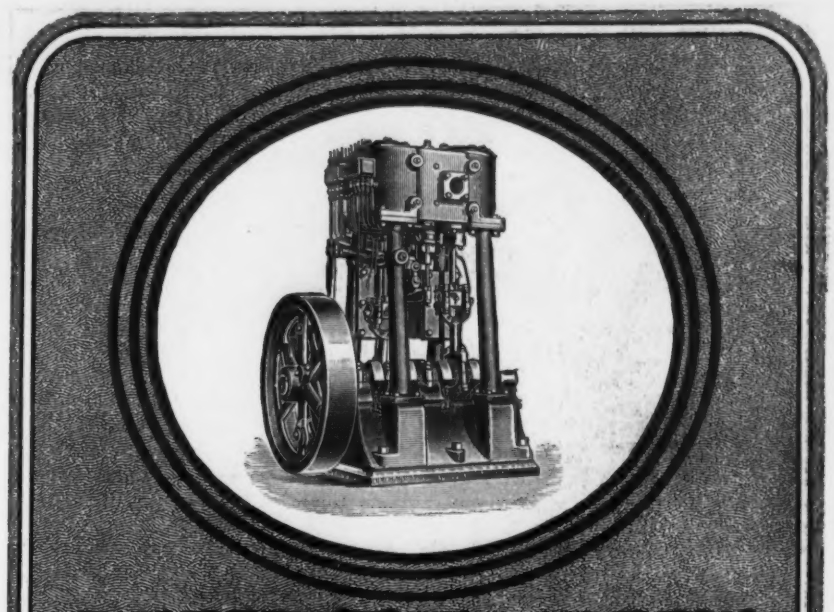

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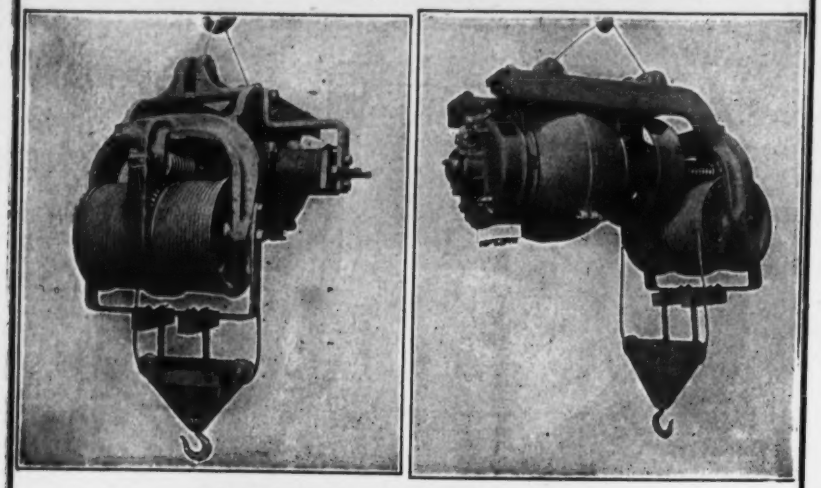

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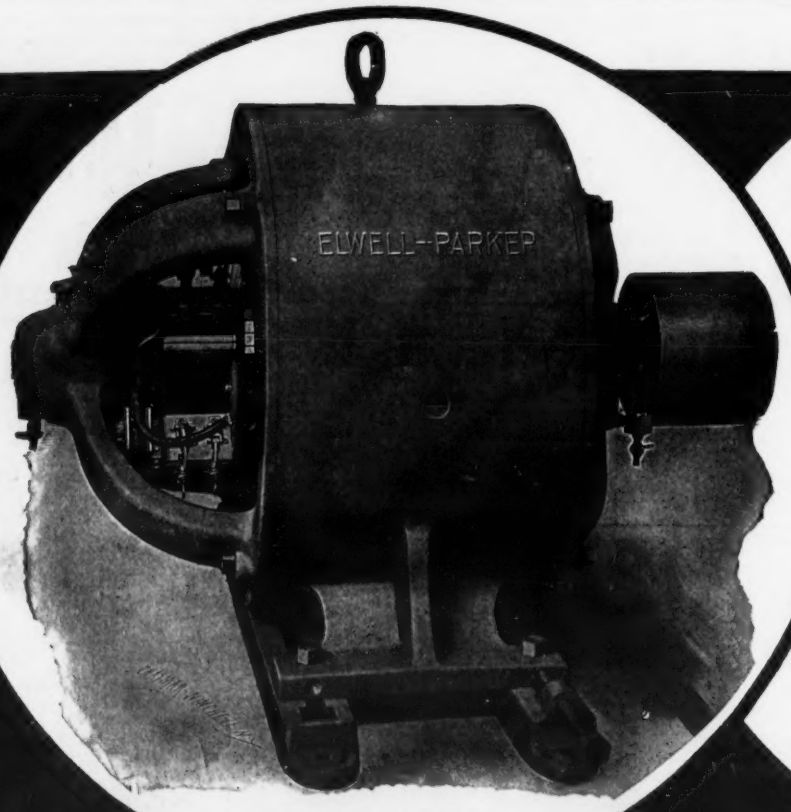

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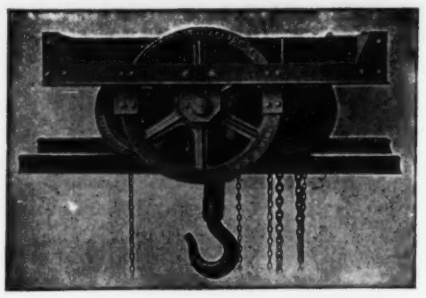

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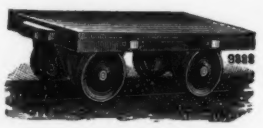

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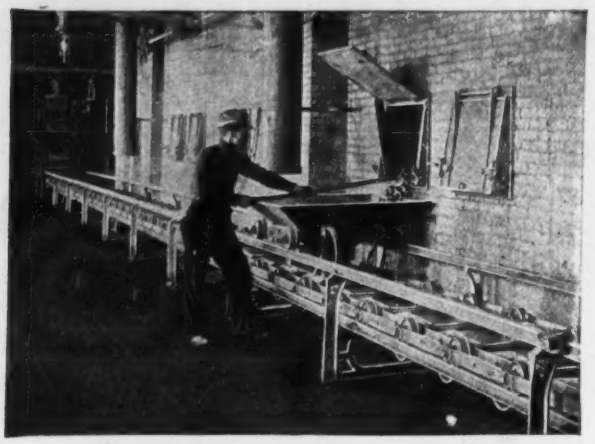

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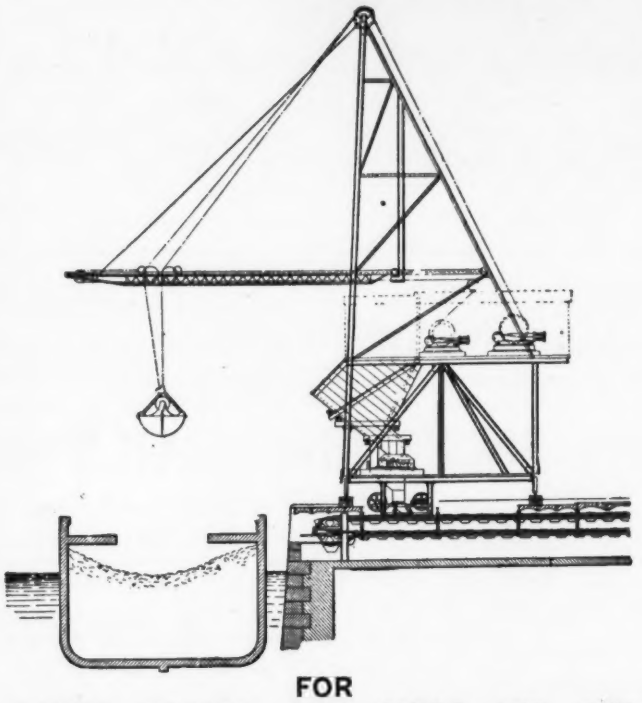

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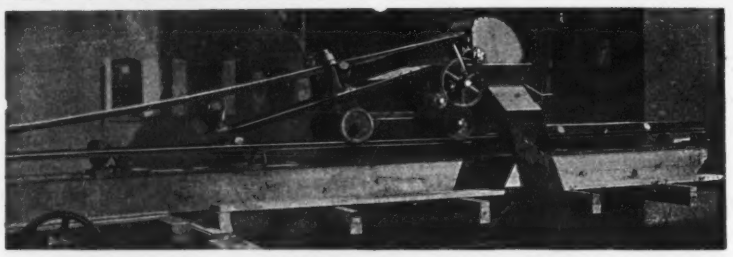

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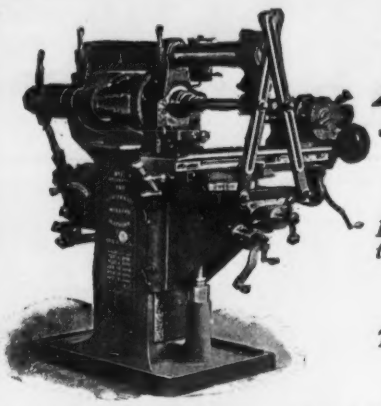

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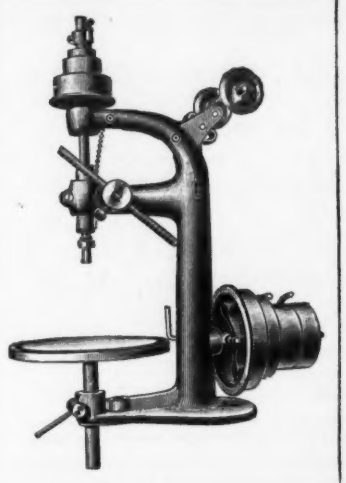

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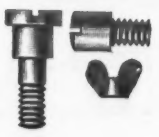

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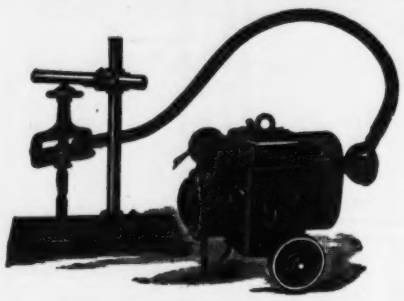

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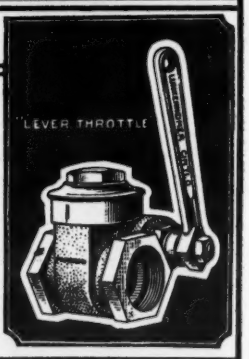

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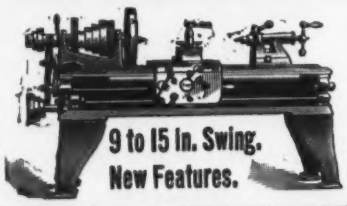

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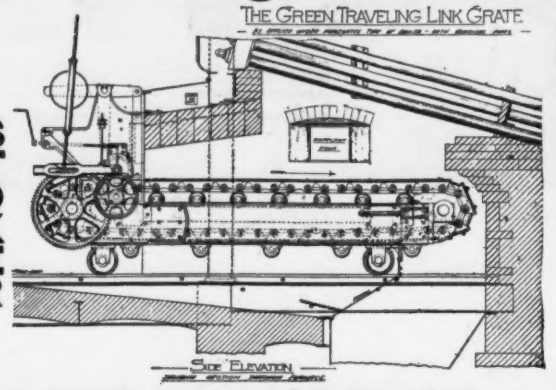

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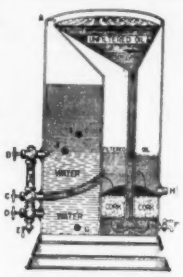

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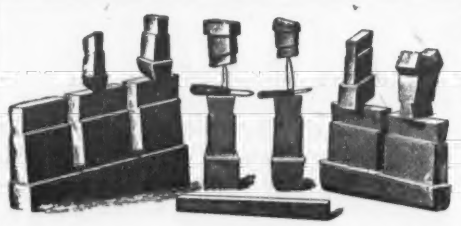

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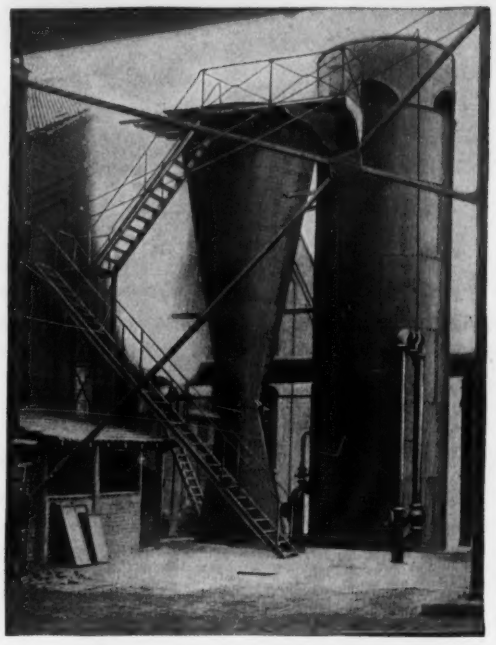

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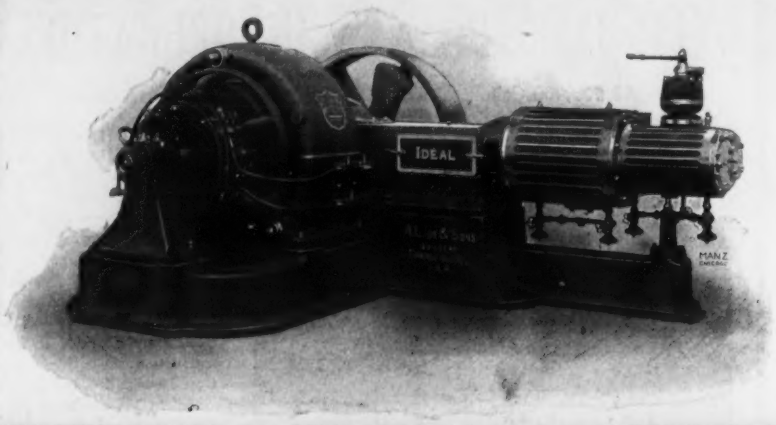

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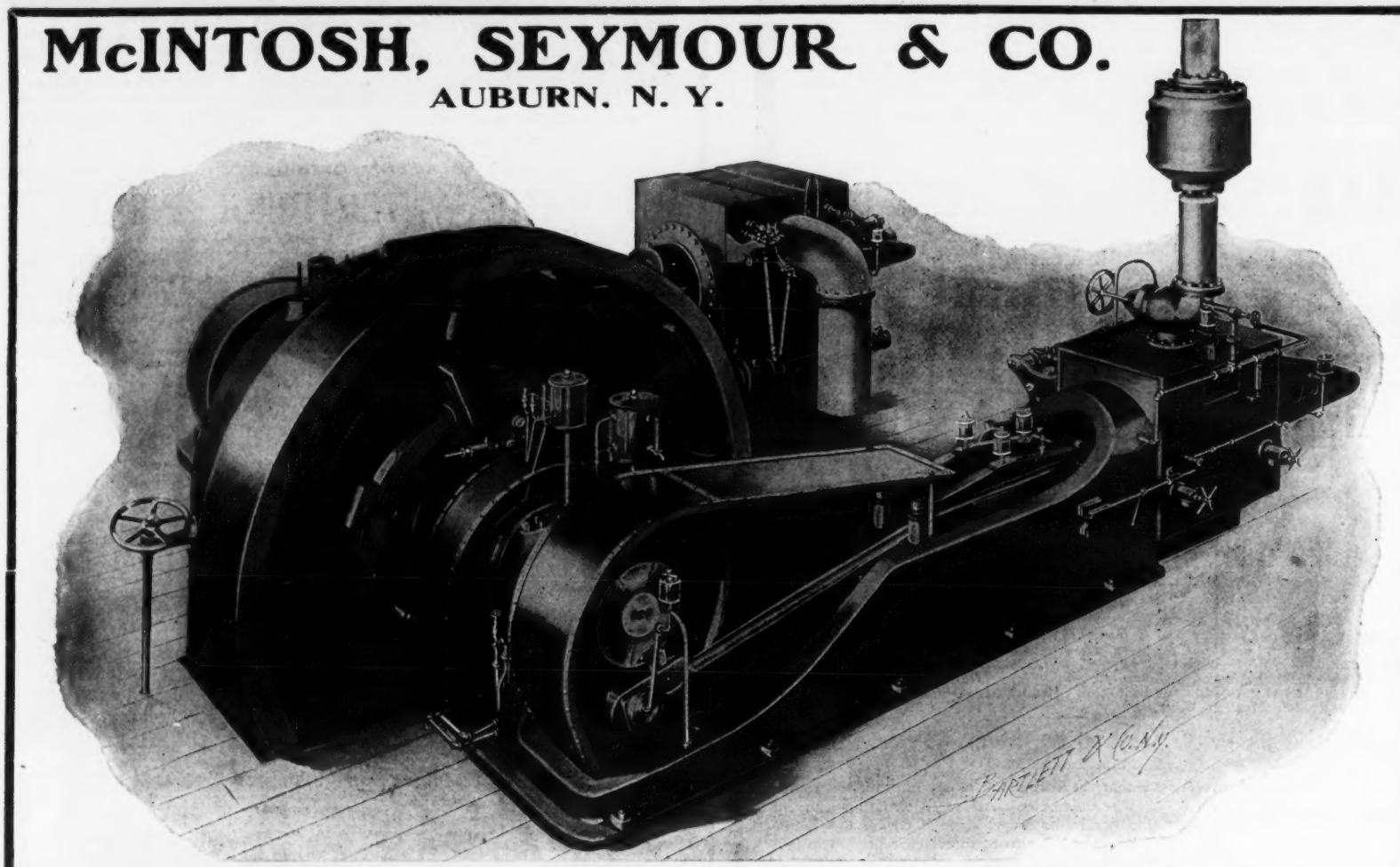

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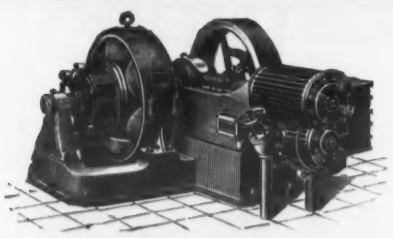

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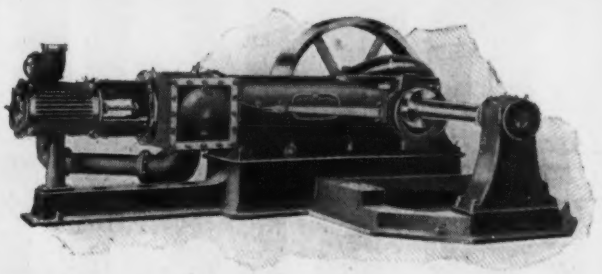

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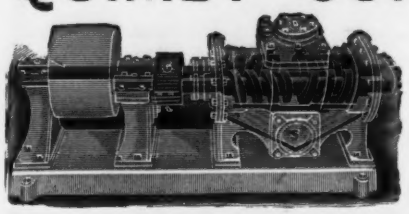

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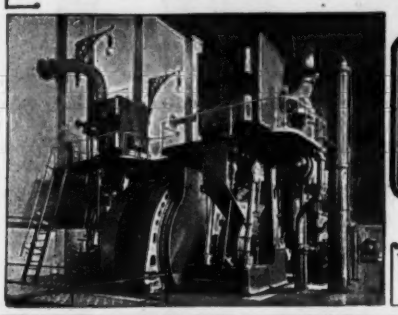

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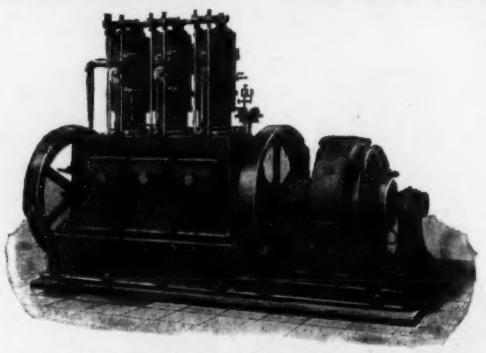

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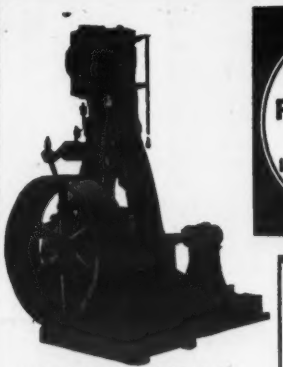

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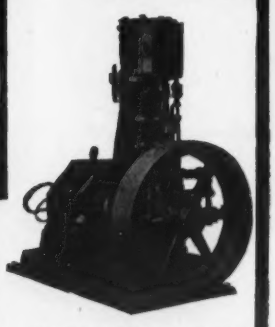

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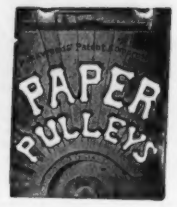

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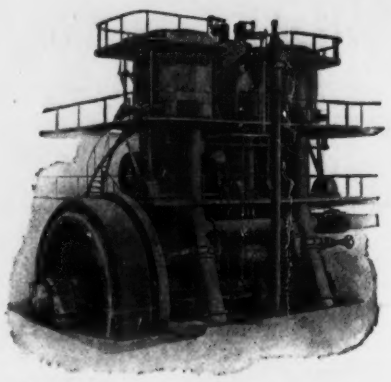

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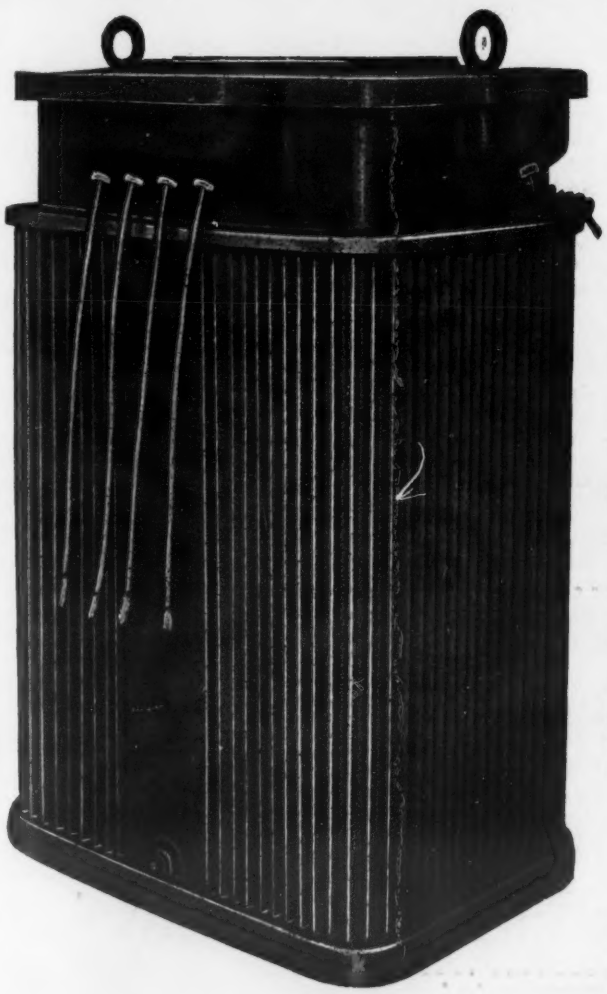

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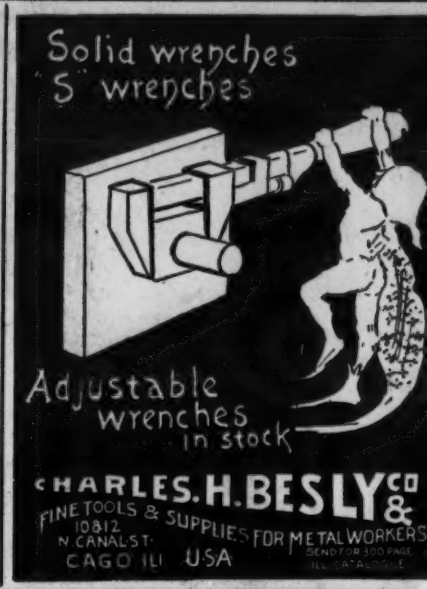

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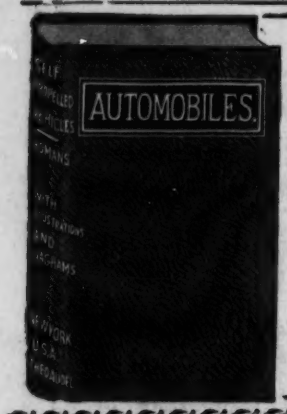

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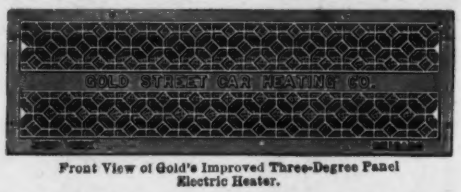

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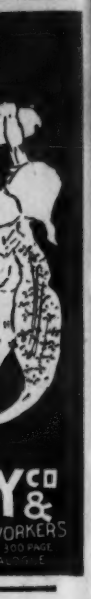

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